CHAPTER 76

ENGINE CONTROLS

LIST OF EFFECTIVE PAGES

N, R or D indicates pages which are New, Revised or Deleted respectively.

Remove and insert the affected pages and complete the Record of Revisions and the Record of Temporary Revisions as necessary.



MAINTENANCE MANUAL

CHAPTER 76

ENGINE CONTROLS

LIST OF EFFECTIVE PAGES

N, R or D indicates pages which are New, Revised or Deleted respectively.

Remove and insert the affected pages and complete the Record of Revisions and the Record of Temporary Revisions as necessary.

CH/SE/SU	C	PAGE	DATE	CH/SE/SU	C	PAGE	DATE
S.B.LIST		1	Mar 31/99	76-00-00		408	Feb 28/81
S.B.LIST		2	Mar 31/99	76-00-00		409	Feb 28/81
S.B.LIST		3	Mar 31/99	76-00-00		410	Feb 28/81
S.B.LIST		4	Mar 31/99	76-00-00		411	Feb 28/81
S.B.LIST		5	Mar 31/99	76-00-00		412	Feb 28/81
S.B.LIST		6	Mar 31/99	76-00-00		413	Feb 28/81
S.B.LIST		7	Mar 31/99	76-00-00		414	Feb 28/81
S.B.LIST		8	Mar 28/02	76-00-00		415	Feb 28/81
S.B.LIST		8A	Mar 28/02	76-00-00		416	Feb 28/81
S.B.LIST		8B	Mar 28/02	76-00-00		417	Feb 28/81
S.B.LIST		9	Mar 31/99	76-00-00		418	Feb 28/81
S.B.LIST		10	Mar 31/99	76-00-00		419	Feb 28/81
S.B.LIST		11	Mar 31/99	76-00-00		420	Feb 28/81
S.B.LIST		12	Mar 31/99	76-00-00		421	Nov 30/82
S.B.LIST		13	Mar 31/99	76-00-00		422	Feb 28/81
S.B.LIST		14	Mar 28/02	76-00-00		423	Feb 28/81
				76-00-00		424	Feb 28/81
T. of C.		1	Mar 31/00	76-00-00		425	Feb 28/81
T. of C.		2	Mar 31/00	76-00-00		426	Feb 28/81
T. of C.		3	Mar 31/00	76-00-00		427	Feb 28/81
T. of C.		4	Mar 31/00	76-00-00		428	Feb 28/81
T. of C.		5	Mar 31/00	76-00-00		429	Feb 28/81
T. of C.		6	Mar 31/00	76-00-00		430	Feb 28/81
T. of C.		7	Mar 28/02	76-00-00		431	Feb 28/81
T. of C.		8	Mar 31/00	76-00-00		432	Feb 28/81
T. of C.		9	Mar 31/00	76-00-00		433	Feb 28/81
				76-00-00		434	Feb 28/81
76-00-00		1	Nov 30/75	76-00-00		435	Feb 28/81
76-00-00		2	Nov 30/75	76-00-00		436	Feb 28/81
76-00-00		3	Nov 30/75	76-00-00		437	Feb 28/81
76-00-00		4	Nov 30/75	76-00-00		438	Feb 28/81
76-00-00		401	Feb 28/81	76-00-00		439	Feb 28/81
76-00-00		402	Feb 28/81	76-00-00		440	Feb 28/81
76-00-00		403	Feb 28/81	76-00-00		441	Feb 28/81
76-00-00		404	Feb 28/81	76-00-00		442	Feb 28/81
76-00-00		405	Feb 28/81	76-00-00		443	Feb 28/80
76-00-00		406	Feb 28/81	76-00-00		444	Feb 28/81
76-00-00		407	Feb 28/81	76-00-00		445	Feb 28/81

CH/SE/SU	C	PAGE	DATE	CH/SE/SU	C	PAGE	DATE
76-00-00		446	Feb 28/81	76-10-00		32	Nov 30/81
76-00-00		501	Nov 30/80	76-10-00		33	Nov 30/78
76-00-00		502	Nov 30/80	76-10-00		34	Nov 30/78
76-00-00		503	Nov 30/80	76-10-00		35	Nov 30/81
76-00-00		504	Feb 28/78	76-10-00		36	Nov 30/81
76-00-00		505	Nov 30/80	76-10-00		37	Nov 30/78
76-00-00		506	Nov 30/80	76-10-00		38	Nov 30/81
76-00-00		507	Nov 30/80	76-10-00		39	Nov 30/78
76-00-00		508	Nov 30/80	76-10-00		40	Nov 30/81
76-00-00		509	Nov 30/80	76-10-00		41	Nov 30/81
76-00-00		510	Nov 30/80	76-10-00		42	Nov 30/81
76-00-00		511	Nov 30/80	76-10-00		43	Nov 30/78
76-00-00		512	Nov 30/80	76-10-00		44	Nov 30/81
76-00-00		513	Nov 30/80	76-10-00		45	Nov 30/78
76-00-00		514	Nov 30/80	76-10-00		46	Nov 30/81
76-00-00		515	Nov 30/80	76-10-00		47	Nov 30/81
76-00-00		516	Nov 30/80	76-10-00		48	Nov 30/81
76-00-00		517	Nov 30/80	76-10-00		49	Nov 30/81
				76-10-00		50	Nov 30/81
76-10-00		1	Nov 30/78	76-10-00		51	Nov 30/81
76-10-00		2	Nov 30/78	76-10-00		52	Nov 30/81
76-10-00		3	Nov 30/78	76-10-00		53	Nov 30/78
76-10-00		4	Nov 30/78	76-10-00		54	Nov 30/81
76-10-00		5	Nov 30/78	76-10-00		55	Nov 30/81
76-10-00		6	Nov 30/78	76-10-00		56	Nov 30/78
76-10-00		7	Nov 30/81	76-10-00		57	Nov 30/81
76-10-00		8	Nov 30/78	76-10-00		58	Nov 30/81
76-10-00		9	Nov 30/81	76-10-00		59	Nov 30/81
76-10-00		10	Nov 30/81	76-10-00		60	Nov 30/78
76-10-00		11	Nov 30/81	76-10-00		61	Nov 30/81
76-10-00		12	Nov 30/78	76-10-00		62	Nov 30/81
76-10-00		13	Feb 28/79	76-10-00		63	Mar 31/95
76-10-00		14	Nov 30/81	76-10-00		64	Mar 31/95
76-10-00		15	Nov 30/78	76-10-00		65	Mar 31/95
76-10-00		16	Nov 30/81	76-10-00		66	Nov 30/81
76-10-00		17	Nov 30/78	76-10-00		501	May 30/79
76-10-00		18	Nov 30/78	76-10-00		502	May 30/79
76-10-00		19	Nov 30/78	76-10-00		503	May 30/79
76-10-00		20	Nov 30/81	76-10-00		504	Feb 28/79
76-10-00		21	Nov 30/78	76-10-00		505	May 30/79
76-10-00		22	Nov 30/81	76-10-00		506	May 30/79
76-10-00		23	Nov 30/78	76-10-00		507	May 30/79
76-10-00		24	Nov 30/78	76-10-00		508	May 30/79
76-10-00		25	Nov 30/81	76-10-00		509	May 30/79
76-10-00		26	Feb 28/79	76-10-00		510	May 30/79
76-10-00		27	Nov 30/78				
76-10-00		28	Nov 30/81	76-11-00		501	Mar 31/95
76-10-00		29	Nov 30/81	76-11-00		502	Mar 31/95
76-10-00		30	Nov 30/81	76-11-00		503	Mar 31/95
76-10-00		31	Nov 30/81	76-11-00		504	Mar 31/95

CH/SE/SU	C	PAGE	DATE	CH/SE/SU	C	PAGE	DATE
76-11-00		504 A	Mar 31/95	76-11-00		551	May 30/82
76-11-00		504 B	Mar 31/95	76-11-00		552	May 30/82
76-11-00		505	May 30/82	76-11-00		553	May 30/82
76-11-00		506	May 30/82	76-11-00		554	May 30/82
76-11-00		506 A	Mar 29/96	76-11-00		555	May 30/82
76-11-00		506 B	Mar 31/95	76-11-00		556	May 30/82
76-11-00		507	May 30/82	76-11-00		557	May 30/82
76-11-00		508	May 30/82	76-11-00		558	May 30/82
76-11-00		509	May 30/82	76-11-00		559	May 30/82
76-11-00		510	May 30/82	76-11-00		560	May 30/82
76-11-00		511	May 30/82	76-11-00		561	May 30/82
76-11-00		512	May 30/82	76-11-00		562	May 30/82
76-11-00		513	May 30/82	76-11-00		563	May 30/82
76-11-00		514	May 30/82	76-11-00		564	May 30/82
76-11-00		515	May 30/82	76-11-00		565	May 30/82
76-11-00		516	May 30/82	76-11-00		566	May 30/82
76-11-00		517	May 30/82	76-11-00		567	May 30/82
76-11-00		518	May 30/82	76-11-00		568	May 30/82
76-11-00		519	May 30/82	76-11-00		569	May 30/82
76-11-00		520	May 30/82	76-11-00		570	May 30/82
76-11-00		521	May 30/82	76-11-00		571	May 30/82
76-11-00		522	May 30/82	76-11-00		572	May 30/82
76-11-00		523	May 30/82	76-11-00		573	May 30/82
76-11-00		524	May 30/82	76-11-00		574	May 30/82
76-11-00		525	May 30/82	76-11-00		575	May 30/82
76-11-00		526	May 30/82	76-11-00		576	May 30/82
76-11-00		527	May 30/82	76-11-00		577	May 30/82
76-11-00		528	May 30/82	76-11-00		578	May 30/82
76-11-00		529	May 30/82	76-11-00		579	May 30/82
76-11-00		530	May 30/82	76-11-00		580	May 30/82
76-11-00		531	May 30/82	76-11-00		581	May 30/82
76-11-00		532	May 30/82	76-11-00		582	May 30/82
76-11-00		533	May 30/82	76-11-00		583	May 30/82
76-11-00		534	May 30/82	76-11-00		584	May 30/82
76-11-00		535	May 30/82	76-11-00		585	May 30/82
76-11-00		536	May 30/82	76-11-00		586	May 30/82
76-11-00		537	May 30/82	76-11-00		587	May 30/82
76-11-00		538	May 30/82	76-11-00		588	May 30/82
76-11-00		539	May 30/82	76-11-00		589	May 30/82
76-11-00		540	May 30/82	76-11-00		590	May 30/82
76-11-00		541	May 30/82	76-11-00		591	May 30/83
76-11-00		542	May 30/82	76-11-00		592	May 30/83
76-11-00		543	May 30/82	76-11-00		592 A	May 30/83
76-11-00		544	May 30/82	76-11-00		592 B	May 30/83
76-11-00		545	May 30/82	76-11-00		593	May 30/82
76-11-00		546	May 30/82	76-11-00		594	May 30/82
76-11-00		547	May 30/82	76-11-00		595	May 30/82
76-11-00		548	May 30/82	76-11-00		596	May 30/82
76-11-00		549	May 30/82	76-11-00		597	May 30/82
76-11-00		550	May 30/82	76-11-00		598	May 30/82

CH/SE/SU	C	PAGE	DATE	CH/SE/SU	C	PAGE	DATE
76-11-00		598.1	May 30/82	76-11-11		15	May 30/79
76-11-00		598.2	May 30/82	76-11-11		16	Feb 29/80
76-11-00		598.3	May 30/82	76-11-11		17	Feb 29/80
76-11-00		598.4	May 30/82	76-11-11		18	Feb 29/80
76-11-00		598.5	May 30/82	76-11-11		19	May 30/79
76-11-00		598.6	Mar 29/96	76-11-11		20	May 30/79
76-11-00		598.7	Mar 29/96	76-11-11		21	Feb 29/80
76-11-00		598.8	Mar 29/96	76-11-11		22	Feb 29/80
76-11-00		598.9	Mar 29/96	76-11-11		23	Feb 29/80
76-11-00		598.10	Mar 29/96	76-11-11		24	Feb 29/80
76-11-00		598.11	Mar 29/96	76-11-11		25	Feb 29/80
76-11-00		598.12	Mar 29/96	76-11-11		26	Feb 29/80
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76-11-01		2	May 30/81	76-11-11		28	Feb 29/80
76-11-01		3	Nov 30/78	76-11-11		29	Feb 29/80
76-11-01		401	Feb 29/80	76-11-11		30	Feb 29/80
76-11-01		402	Feb 29/80	76-11-11		401	Feb 28/81
76-11-01	R	403	May 31/03	76-11-11		402	Nov 30/80
76-11-01		404	May 30/83	76-11-11		403	Nov 30/80
76-11-01		405	May 30/83	76-11-11		404	Nov 30/80
76-11-01		406	Mar 30/01	76-11-11		405	Sep 30/86
76-11-01		406A	Mar 30/01	76-11-11		501	Nov 30/80
76-11-01		406B	May 30/83	76-11-11		502	Nov 30/80
76-11-01		407	Nov 30/75	76-11-12		401	May 30/78
76-11-01		408	Nov 30/83	76-11-12		402	May 30/78
76-11-01	R	409	May 31/03	76-11-12		403	May 30/78
76-11-01		410	Feb 29/80	76-11-12		404	May 30/78
76-11-01		501	May 30/77	76-11-12		405	May 30/78
76-11-01		502	May 30/77	76-11-12		406	May 30/78
76-11-01		503	May 30/77	76-11-12		501	Nov 30/75
76-11-01		504	May 30/77	76-11-12		502	Nov 30/75
76-11-01		505	May 30/77	76-11-12		503	Nov 30/75
76-11-01		506	May 30/77	76-11-12		504	Aug 30/75
76-11-01		507	May 30/77	76-11-12		505	May 30/76
76-11-01		508	May 30/77	76-11-12		506	Aug 30/75
76-11-01		509	May 30/77	76-11-12		507	Aug 30/75
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76-11-11		2	Feb 29/80	76-11-14		401	Nov 30/80
76-11-11		3	May 30/79	76-11-14		402	Nov 30/80
76-11-11		4	Feb 29/80	76-11-14		403	Nov 30/80
76-11-11		5	May 30/79	76-11-14		404	Nov 30/80
76-11-11		6	Feb 29/80	76-11-14		405	Nov 30/80
76-11-11		7	Feb 29/80	76-11-14		501	Aug 30/77
76-11-11		8	May 30/79	76-11-14		502	May 30/77
76-11-11		9	Feb 29/80	76-11-14		503	Aug 30/79
76-11-11		10	Feb 29/80	76-11-14		601	Feb 28/81
76-11-11		11	May 30/79	76-11-14		602	Feb 28/81
76-11-11		12	Feb 29/80	76-11-14		603	Feb 28/81
76-11-11		13	May 30/79	76-11-15		401	May 30/78
76-11-11		14	Feb 29/80	76-11-15		402	May 30/78

CH/SE/SU	C	PAGE	DATE	CH/SE/SU	C	PAGE	DATE
76-11-15		403	May 30/78	76-11-18		402	Feb 29/80
76-11-15		404	May 30/78	76-11-18		403	Feb 29/80
76-11-15		405	May 30/78	76-11-18		404	Feb 29/80
76-11-15		406	May 30/78	76-11-18		405	Feb 29/80
76-11-15		407	May 30/78	76-11-18		406	May 30/78
76-11-15		408	May 30/78	76-11-18		407	May 30/78
76-11-15		409	May 30/78	76-11-18		408	Feb 29/80
76-11-15		501	May 30/78	76-11-18		409	Feb 29/80
76-11-15		502	May 30/78	76-11-18		410	Feb 29/80
76-11-15		503	May 30/78	76-11-18		411	Feb 29/80
76-11-15		504	May 30/78	76-11-18		412	Feb 29/80
76-11-15		505	May 30/78	76-11-18		413	Feb 29/80
76-11-15		506	May 30/78	76-11-18		414	Feb 29/80
76-11-15		507	May 30/78	76-11-18		415	Feb 29/80
76-11-15		508	May 30/78	76-11-18		416	Feb 29/80
76-11-16		401	Aug 30/77	76-11-18		417	Feb 29/80
76-11-16		402	May 30/78	76-11-22		401	Feb 29/80
76-11-16		403	Mar 28/02	76-11-22		402	Feb 29/80
76-11-16		404	May 30/78	76-11-22		403	Feb 29/80
76-11-16		405	May 30/78	76-11-22		404	Nov 30/78
76-11-16		406	May 30/78	76-11-22		405	Feb 29/80
76-11-16		407	May 30/78	76-11-22		406	Nov 30/78
76-11-16		408	Sep 30/88	76-11-22		407	Feb 29/80
76-11-16		409	Sep 30/88	76-11-22		408	Feb 29/80
76-11-16		410	Sep 30/88	76-11-22		409	Feb 29/80
76-11-16		411	Sep 30/88	76-11-22		410	Feb 29/80
76-11-16		412	Sep 30/88	76-11-23		401	May 30/77
76-11-16		412 A	Sep 30/88	76-11-23		402	May 30/77
76-11-16		412 B	Sep 30/88	76-11-23		403	May 30/77
76-11-16		413	May 30/78	76-11-23		404	May 30/77
76-11-16		414	May 30/78	76-11-23		405	May 30/77
76-11-16		415	May 30/78	76-11-23		406	May 30/77
76-11-16		416	Nov 30/85	76-11-23		407	May 30/77
76-11-16		417	May 30/78	76-11-23		408	May 30/77
76-11-16		418	May 30/78	76-11-24		401	Aug 30/80
76-11-16		419	Mar 28/02	76-11-24		402	May 30/78
76-11-16		420	May 30/78	76-11-24		403	May 30/78
76-11-16		421	May 30/78	76-11-24		404	Aug 30/80
76-11-17		401	Nov 30/78	76-11-24		405	Aug 30/80
76-11-17		402	Nov 30/78	76-11-24		406	Aug 30/80
76-11-17		403	Nov 30/78	76-11-24		407	May 30/78
76-11-17		404	Nov 30/78	76-11-24		408	Aug 30/80
76-11-17		405	Nov 30/78	76-11-24		409	Aug 30/80
76-11-17		406	Nov 30/78	76-11-24		501	May 30/78
76-11-17		407	Nov 30/78	76-11-24		502	May 30/78
76-11-17		501	Aug 30/77	76-11-24		503	May 30/78
76-11-17		502	May 30/77	76-11-24		504	Feb 29/76
76-11-17		503	Aug 30/77	76-11-24		505	Nov 30/75
76-11-17		504	Aug 30/77	76-11-24		506	Feb 29/76
76-11-18		401	Feb 29/80	76-11-24		507	May 30/78

CH/SE/SU	C	PAGE	DATE
76-11-24		508	May 30/78
76-11-24		509	May 30/78
76-11-25		401	May 30/77
76-11-25		402	May 30/77
76-11-25		403	May 30/77
76-11-25		404	May 30/77
76-11-25		405	May 30/77
76-11-25		406	May 30/77
76-11-25		407	May 30/77
76-11-25		408	May 30/77
76-11-25		409	May 30/77
76-11-26		401	May 30/77
76-11-26		402	May 30/77
76-11-26		403	Nov 30/76
76-11-26		404	Nov 30/76
76-11-26		405	Nov 30/76
76-11-26		406	Nov 30/76
76-11-26		407	Nov 30/76
76-12-00		1	Nov 30/75
76-12-00		2	Nov 30/75
76-12-00		3	Aug 30/76
76-12-00		4	Nov 30/75
76-12-01	R	401	May 31/03
76-12-01	R	402	May 31/03
76-12-01		403	Mar 27/97
76-12-01		501	Aug 30/80
76-12-01		502	Aug 30/80
76-12-01		503	Aug 30/80
76-12-01		504	Aug 30/80
76-12-01		505	Aug 30/80
76-12-01		506	Aug 30/80
76-12-02		401	Nov 30/83
76-12-02		402	Nov 30/75
76-12-02		403	Nov 30/83
76-12-02		501	Aug 30/80
76-12-02		502	Aug 30/80
76-12-02		503	Aug 30/80
76-12-02		504	Aug 30/80
76-12-02		505	Aug 30/80
76-12-02		506	Aug 30/80
76-13-03		401	Mar 27/97
76-13-03		402	Mar 27/97
76-13-03	R	403	May 31/03
76-13-03		404	Mar 27/97
76-13-11		1	Nov 30/77
76-13-11		2	Nov 30/77
76-13-11		3	Nov 30/77
76-13-11		4	Nov 30/77
76-13-11		301	Mar 28/02
76-13-11		302	Nov 30/75
76-13-11		401	Mar 28/02
76-13-11		402	Mar 28/02
76-13-11		403	Aug 30/77
76-13-11		404	Sep 30/92
76-13-11		405	Nov 30/80
76-13-12		1	Nov 30/77
76-13-12		2	Nov 30/77
76-13-12		3	Nov 30/77
76-13-12		4	Nov 30/77
76-13-12		401	Mar 28/02
76-13-12		402	Mar 28/02
76-13-12		403	Mar 29/96
76-13-12		404	Mar 29/96
76-13-12		405	Mar 29/96
76-13-12		406	Mar 29/96
76-13-21		101	Feb 28/81
76-13-21		102	Nov 30/80
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SERVICE BULLETIN LIST

In the following service bulletin list, SB indicates an aircraft manufacturers bulletin, AEB indicates an airline engineering bulletin and OL indicates an engine manufacturers bulletin (complete identification OL.593-XX-XXX).

	SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
	OL 71-015		May 30/77	Embodied Power plant - Engine electrical cables - Introduction of stainless steel connectors
	OL 73-001		May 30/77	Embodied Engine fuel and control - Fuel pipe system - New drain valve assembly
	OL 76-A07			Applicable Engine controls - LP shaft signal system - Cylinder and piston section - Inspection of tube shield
R	OL 76-A07			CANCELLED
	OL 76-001			Applicable Engine controls - Throttle valve control actuator - Introduction of two segmental spacing collars and retaining rings
	OL 76-002			Applicable Engine controls - LP shaft signal system - Redesigned shaft actuator arm
	OL 76-003			Applicable Engine controls - Primary nozzle control assembly trim unit - Modified mounting brackets
	OL 76-003	01		Applicable Engine controls - Primary nozzle control assembly trim unit - Modified mounting brackets
	OL 76-003	02		Applicable Engine controls - Primary nozzle control assembly trim unit - Modified mounting brackets
	OL 76-003	03		Applicable Engine controls - Primary nozzle control assembly trim unit - Modified mounting brackets
	OL 76-003	04		Applicable Engine controls - Primary nozzle control assembly trim unit - Modified mounting brackets

	SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
R	OL 76-003	05		CANCELLED
	OL 76-004			Applicable Engine controls - LP and HP compressor rpm probes - Inspection for ingress of foreign matter
	OL 76-005			Applicable Engine controls - Reheat control amplifier - Modification of time base printed card
	OL 76-005	01		Applicable Engine controls - Reheat control amplifier - Modification of time base printed card
	OL 76-005	02		Applicable Engine controls - Reheat control amplifier - Modification of time base printed card
	OL 76-006			Applicable Engine controls - Control amplifier engine electrical control system (normal and alternate) - Revised setting of N1
	OL 76-008			Applicable Engine controls - LH shaft signal system - Cylinder and piston section - Modified tube shield
R	OL 76-008	01		Applicable Engine controls - LH shaft signal system - Cylinder and piston section - Modified tube shield
	OL 76-009			Applicable Engine controls - LP compressor rpm probe - Silver plated Corruplus seals
	OL 76-010			Applicable Engine controls - HP compressor rpm probe - New standard of HP tachometer probe
	OL 76-011			Applicable Engine controls - LP compressor rpm probe - New standard of LP tachometer probe

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
OL 76-012			Applicable Engine controls - Control amplifier engine electrical control system (normal and alternate) - Introduction of amplifier P/A6A16/24BB
OL 76-013			No effect Engine controls - Primary nozzle control assembly trim unit - Oil in use stencilled on cover assembly
OL 76-013	01		Applicable Engine controls - Primary nozzle control assembly trim unit - Oil in use stencilled on cover assembly
R OL 76-013			CANCELLED
OL 76-014			Applicable Engine control - Cylinder piston section with front and centre cable assemblies - Modified clamp block
OL 76-015			Applicable Engine control - Control amplifier engine electrical control system (normal and alternative) - Introduction of amplifier types P/A6A16/24AL and /24BC
OL 76-015	01		Applicable Engine control - Control amplifier engine electrical control system (normal and alternative) - Introduction of amplifier types P/A6A16/24AL and /24BC
OL 76-016			Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Change of seal
OL 76-016	01		Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Change of seal
OL 76-017			Embodied Engine controls - LP shaft signal systems - Front and intermediate roller blocks - Removal of outer rollers
R OL 76-017			CANCELLED

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
OL 76-018			Applicable Engine controls - Cylinder piston section with front and centre cable assemblies - Inspection for freedom of movement of reset plunger
OL 76-018	01		Applicable Engine controls - Cylinder piston section with front and centre cable assemblies - Inspection for freedom of movement of reset plunger
OL 76-018	02		Applicable Engine controls - Cylinder piston section with front and centre cable assemblies - Inspection for freedom of movement of reset plunger
OL 76-019			Not applicable
OL 76-020			Applicable Engine controls - Actuator Gearbox (TV) - Introduction on engines of Lucas Actuator Gearbox type AGB103 and 103m to the standard of Lucas Mod. CP4922
OL 76-020	01		Applicable Engine controls - Actuator Gearbox (TV) - Introduction on engines of Lucas Actuator Gearbox type AGB103 and 103m to the standard of Lucas Mod. CP4922
OL 76-021			Applicable Engine controls - Reheat control amplifier - Readjustment of a potentio-meter on the Pre amplifier card
OL 76-021	01		Applicable Engine controls - Reheat control amplifier - Readjustment of a potentio-meter on the Pre amplifier card
OL 76-022			Applicable Engine controls - Throttle valve actuator gearbox - Introduction on engines of TVA gearbox types AGB103 or 103m to the standard of Lucas Mod.CP5165

	SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
	OL 76-023			Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Introduction of debris guard
R	OL 76-023	01		Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Introduction of debris guard
	OL 76-024			Applicable Engine - LP shaft signal system - Rear cable shouldered pins
	OL 76-025			Applicable Engine controls - LP shaft signal system - Modified front cable shield tube Flanged adapter and fitting and bush guide valves
	OL 76-026			Applicable Engine controls - LP shaft signal system - Introduction of new cable run and guides
	OL 76-026	01		Applicable Engine controls - LP shaft signal system - Introduction of new cable run and guides
	OL 76-026	02		Applicable Engine controls - LP shaft signal system - Introduction of new cable run and guides
R	OL 76-026	03		Applicable Engine controls - LP shaft signal system - Introduction of new cable run and guides
R	OL 76-026	04		Applicable Engine controls - LP shaft signal system - Introduction of new cable run and guides
R	OL 76-026	05		Applicable Engine controls - LP shaft signal system - Introduction of new cable run and guides

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
OL 76-027			Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier type A6A16/24CA to the standard of Ultra modification No.U1014
OL 76-027	01		Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier type A6A16/24CA to the standard of Ultra modification No.U1014
OL 76-028			Applicable Engine controls - LP shaft signal system - Introduction of increased diametral clearance between piston and cylinder
OL 76-029			Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Inspection for removal of identification clip assembly (transportation part)
R OL 76-029			CANCELLED
OL 76-030			Applicable Engine controls - LP shaft signal system - Inspection of centre and rear cables
OL 76-030	01		Applicable Engine controls - LP shaft signal system - Inspection of centre and rear cables
R OL 76-030			CANCELLED
OL 76-031			Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier type P/A6A16/24CA to the standard of Ultra modification No. U1017
OL 76-032			Embodied Engine controls. Throttle valve actuator gearbox (AGB) - Introduction on engines of throttle valve actuator gearbox types AGB103 and AGB103M to the standard of Lucas modification CP5307

	SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
	OL 76-033			Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Intro-duction of new servo pin and end cap/ Revised carbon seal rings
	OL 76-033	01		Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Intro-duction of new servo pin and end cap/ Revised carbon seal rings
R	OL 76-033	02		Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Intro-duction of new servo pin and end cap/ Revised carbon seal rings
	OL 76-034			Applicable Engine indicating - LP shaft signal system - Support bracket and rear block assembly
	OL 76-035			Applicable Engine controls - Actuator gearbox - Introduction on engines of actuator gearbox types AGB103 or 103M to the standard of Lucas modification CP5251
	OL 76-036			Applicable Engine controls - Primary nozzle control trim unit - Introduction of modifications to improve reliability
	OL 76-036	01		Applicable Engine controls - Primary nozzle control trim unit - Introduction of modifications to improve reliability
	OL 76-037			Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Improved surface finish in piston valve bore
R	OL 76-037	01		Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Improved surface finish in piston valve bore

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
OL 76-038			Applicable Engine controls - Primary nozzle control pneumatic valve (PNC) - Inspection of feedback needle for cracks
OL 76-039			Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Exhaust outlet position blanked
R OL 76-039	01		Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Exhaust outlet position blanked
OL 76-040			Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Feedback needle with anti-corrosion treatment
OL 76-040	01		Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Feedback needle with anti-corrosion treatment
OL 76-040	02		Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Feedback needle with anti-corrosion treatment
OL 76-041			Applicable Engine controls - Primary nozzle control pneumatic valve (PNC) - Inspection of piston for hardness
OL 76-042			Applicable Engine controls - Primary nozzle control assembly pneumatic valve - Introduction of group modifications
OL 76-043			Applicable Engine controls - Primary nozzle control trim unit - Introduction of revised internal link wiring

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
OL 76-043	01		Applicable Engine controls - Primary nozzle control trim unit - Introduction of revised internal link wiring

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION

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	SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
	OL 76-044			Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier type PA6A16/24CC to the standard of Ultra modification No.U1019
	OL 76-045			Applicable Engine controls - Engine electrical control system - Introduction of a fault identification module (FIM) into the engine control amplifier
R	OL 76-045	01		Applicable Engine controls - Engine electrical control system - Introduction of a fault identification module (FIM) into the engine control amplifier
R	OL 76-045	02		Applicable Engine controls - Engine electrical control system - Introduction of a fault identification module (FIM) into the engine control amplifier
R	OL 76-045	03		Applicable Engine controls - Engine electrical control system - Introduction of a fault identification module (FIM) into the engine control amplifier
	OL 76-046			Applicable Engine controls - Primary nozzle control assembly - pneumatic nozzle control valve type PNC 950 - Introduction of revised blanking
	OL 76-047			Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier type PA6A16/24DC to the standard of Ultra modification No.U1021
R	OL 76-047	01		Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier type PA6A16/24DC to the standard of Ultra modification No.U1021

	SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
	OL 76-048			Applicable Engine controls - Actuator gearbox - Inspection of synchro transmitter part no.77244642
	OL 76-049			Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier to the standard of Ultra modification No.U1023
R	OL 76-049	01		Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier to the standard of Ultra modification No.U1023
R	OL 76-050			Applicable Engine controls - Reheat differential pressure switch - Change of material for contact arms and damper spring
R	OL 76-051			Applicable Engine controls - Reheat flame detector - Replacement of the electric cable assembly
	OL 76-052		Mar 31/95	Applicable Engine control - Reheat system - Deletion of controlled purge function of the reheat purge solenoid valve
R	OL 76-052	01		Applicable Engine control - Reheat system - Deletion of controlled purge function of the reheat purge solenoid valve
R	OL 76-053			Not Applicable Engine controls - Primary nozzle control trim unit - Introduction on engines of trim unit types NT951 and NT952 incorporating Motors type N18 MGB 7100 (AC main) and N18 MGB 8100 (AC standby) to the standard of Muirhead Vatric modification No.3.

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
R OL 76-054			Applicable Engine controls - Actuator gearbox (TV) - Introduction on engines of actuator gearbox types AGB 103 and AGB 103M to the standard of Lucas modification CP6026
OL 76-055			Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Introduction of new servo pin
R OL 76-055	01		Applicable Engine controls - Primary nozzle control assembly pneumatic valve (PNC) - Introduction of new servo pin
R OL 76-56			Applicable Engine controls - Actuator gearbox (TV) - Identification inspection on synchro transmitter
OL 76-057			Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier to the standard of Dowty Modification U1027
R OL 76-057	01		Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier to the standard of Dowty Modification U1027
OL 76-058			Applicable Engine controls - Engine electrical system - Introduction of engine control amplifier to the standard of Dowty Modification U1028
R OL 76-058	01		Applicable Engine controls - Engine electrical system - Introduction of engine control amplifier to the standard of Dowty Modification U1028

SB/AEB NO	R	REV	INC. IN REVISION	DESCRIPTION
	OL 76-059			Applicable Engine controls - Primary nozzle control pneumatic valve (PNC) - Introduction of reprofiled P3 air signal inlet and air diffuser
R	OL 76-059	01		Applicable Engine controls - Primary nozzle control pneumatic valve (PNC) - Introduction of reprofiled P3 air signal inlet and air diffuser
R	OL 76-060			Applicable Engine controls - Engine electrical control system - Introduction of engine control amplifier to the standard of Dowty modification U1029
R	OL 76-061			Applicable Inspection of the engine - reheat flame detector - Replacement of the cable assembly
R	OL 76-062			Applicable Engine controls - Primary nozzle control pneumatic valve (PNC) - Modified P3 air signal inlet port
R	OL 76-063			Not Applicable Engine controls - Primary nozzle control valve (PNC) - Inspection of valve body for wall thickness
	OL 76-064		Mar 31/95	Applicable Engine control - Reheat flame detector Replacement of the connector and of the truncated cone end-piece on the flexible pipe assembly
	OL 76-065		Mar 31/95	Applicable Engine controls - Reheat control amplifier - Updating components: preventative maintenance
R	OL 76-065	01		Applicable Engine controls - Reheat control amplifier - Updating components: preventative maintenance

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
OL 76-066			Not Applicable Engine controls - PN Trim Assembly - Introduction of replacement/standby motor tacho-generator with alternative/ replacement material for ceramic ring to the standard of Muirhead Vactric Equipment Ltd. Modification No.941164
R OL 76-066	01		Not Applicable Engine controls - PN Trim Assembly - Introduction of replacement/standby motor tacho-generator with alternative/ replacement material for ceramic ring to the standard of Muirhead Vactric Equipment Ltd. Modification No.941164
R OL 76-067			Applicable Engine controls - LP speed probe - Introduction of new LP speed to Smiths Industries Modification 02
R OL 76-068			Applicable Engine controls - HP pulse probe introduction of Smiths Mod.B1858 to replace corruplus seal with Viton 'O' ring type seal
R OL 76-069			CANCELLED
R OL 76-070			Applicable Engine controls - Primary nozzle controls (PNC) and reheat pressure detector - PNC pitot and reheat pressure detector connector retention bolts in improved material
OL 76-071			Not Applicable Engine controls - LP shaft signal system - Inspect cable conduits and cables for fretting and fraying and refurbish system
R OL 76-071	01		Not Applicable Engine controls - LP shaft signal system - Inspect cable conduits and cables for fretting and fraying and refurbish system

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
OL 76-071	02		Not Applicable Engine Controls - LP shaft signal system - Inspect cable conduits and cables for fretting and fraying and refurbish system
OL 76-072			Applicable Engine Controls - LP shaft signal system - Improved bush retention system and material to prevent bush and cable wear
OL 76-072	01		Applicable Engine Controls - LP shaft signal system - Improved bush retention system and material to prevent bush and cable wear
OL 76-072	02		Applicable Engine Controls - LP shaft signal system - Improved bush retention system and material to prevent bush and cable wear
OL 79-006		May 30/77	Embodied Oil - Oil tank/overflow drain coupling - Modified main oil tank
R OL 76-073			Not applicable Engine controls - Actuator Gearbox (TV) - Introduction of gearbox to the standard of Lucas modification CP8086

CHAPTER 76

ENGINE CONTROLS

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GENERAL - DESCRIPTION/OPERATION

1. General

Engine controls enable the engine power to be adjusted to that required for an aircraft operational mode. To provide the power output demanded from the engine, three basic factors are controlled. These are the engine fuel flow rate, the primary nozzle area and the reheat fuel flow rate. The engine control system components and their actions in providing the power control are described in 76-10-00. Fuel control for the engine and reheat systems is described in 73-20-00.

Air delivery to the engine air intake is under the control of the aircraft variable geometry intakes as described in 71-61-00. The power plant exhaust system includes the twin secondary nozzle assembly which ensures the optimum propulsion performance over a wide range of aircraft speed and also provides a reverse thrust facility as described in 78-00-00.

The high pressure (HP) and the low pressure (LP) rotor assemblies, each consisting of a compressor rotor and a turbine rotor, are free to rotate independently of each other. Engine power is relative to the rotational speeds of the two rotor assemblies. By separate control of each of the rotor assemblies, their speed relationship is regulated so that, with any power requirement, each rotor assembly is operating at its optimum efficiency. Engine power is controlled by regulation of the fuel flow, and consequently engine speed, and is increased by the use of reheat which is operated, when required, in the higher engine speed range.

2. Power Control (Ref. Fig. 001)

The engine and reheat control systems consist primarily of electrical components which form electrical links between manually operated controls in the flight compartment and electro-mechanical operating components at the engine. A two lane control system for the engine is provided by the use of two identical control amplifiers, main and alternate, in each engine control channel. The amplifier selected to be effective in control delivers a controlling output in response to command signals and monitored engine operation signals. The command signals and monitored signals in the two lanes of an engine control channel are shown in Figure 1. The final stage components of the engine control system are the actuator gearbox, which drives the fuel flow control unit (FCU) throttle valve, and the primary nozzle

control trim unit, that imposes control on the pneumatic operating system of the primary nozzle.

The HP rotor assembly speed (N2) is directly controlled by the fuel flow rate. The LP rotor assembly speed (N1) is dependent on the fuel flow rate but is regulated to give the desired speed, relative to the HP rotor assembly, by control of the primary nozzle area. Because a controlled fuel pressure drop acts across the throttle valve orifice, the fuel flow to the combustion system is directly controlled by the throttle valve setting. There is an optimum turbine expansion pressure ratio (T.E.P.R.) for every value of fuel flow and operating condition. It is by regulation of the N1/N2 relationship that this optimum T.E.P.R. is established.

In the reheat control system, a single amplifier controls a reheat fuel controller which is the final stage component. The reheat controller incorporates an electric motor with geared drive to the fuel metering valve and is described in 73-20-00.

An emergency shut-down control, described in 76-20-00, consists of a mechanical link between the LP compressor shaft and a quick shut-down valve in the distribution and dump valve whose operation is described in 73-10-00. An LP compressor shaft failure will activate the system and bring about a rapid engine shut-down.

Engine control and reheat control systems act on pilot's demand, monitor essential engine parameters and impose an automatic control to meet the power demand and to ensure that the engine parameters do not deviate beyond their pre-set limits at any stage of the full range of operation. The engine system, in reponse to the control and monitoring signals, adjusts the throttle valve and primary nozzle settings to effect the best engine performance for the existing operating conditions.

The main parameter governing the engine power output is the HP rotor assembly speed N2. This will be determined by the command signals from the pilots throttle lever as modified by the selected control amplifier in response to the control switch settings. The control amplifier will automatically control the primary nozzle area to establish the LP rotor assembly speed N1 relative to N2 and ensure that no essential engine limitation is exceeded in meeting the power demand. Reheat can be initiated when the engine is within the required operating range. On selection of reheat, the reheat control amplifier will automatically control a light-up sequence and then regulate the reheat fuel flow to the scheduled value.

FUEL INLET FROM FIRST STAGE PUMP
SECOND STAGE PUMP
ALTERNATE LANE
MAIN LANE
ACTUATOR GEARBOX (TV)
FUEL FLOW CONTROL UNIT
REHEAT FUEL CONTROLLER
T1 FROM ADJACENT ENGINE
T1 TO ADJACENT ENGINE ALTERNATE AMPLIFIER
LP COMPRESSOR
HP COMPRESSOR
COMBUSTION CHAMBER
REHEAT INJECTION SYSTEM
T1
N1
N2
EGT
PRIMARY NOZZLE JACK
N1 TO REHEAT CONTROL AMPLIFIER
PRIMARY NOZZLE CONTROL
MAIN AMPLIFIER
FAILURE AUTOMATIC CHANGE OVER
ALTERNATE AMPLIFIER
TRIM UNIT
PNEUMATIC CONTROL VALVE
P3
PJ
AIR INLET
CMR 76 00 00 0 AAM0
ENG. RATING SELECTION
TAKE-OFF
CLIMB
CRUISE
CONTINGENCY
THROTTLE MASTER SWITCH
PILOTS LEVER TRANSMITTER
REHEAT FUEL FLOWMETER
ENGINE FUEL FLOWMETER
Fr
Fe
N1
REHEAT CONTROL AMPLIFIER
REHEAT SELECTOR

Simplified Diagram of Control System
Figure 001

If safety circuits in the effective engine control amplifier detect an internal fault, or a fault in associated electrical components or wiring, then an automatic change-over to the other control lane occurs.

ENGINE CONTROLS - REMOVAL/INSTALLATION

**ON A/C 002-007,

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

These procedures deal with minor electrical components that are common to the system. They also include manufacturers minimum equipment list (MMEL) requirements for deactivation /reactivation of a reheat system.

A. Panels and Equipment

The panels and equipment racks and their associated minor electrical components comprise:

Pilots' left-hand dash panel (2-211):
Indicator engine rating, CTY-T/O-CLB-CRS
Centre Console (9-211):
THROT caption modules
Pilots' roof panel (4-211):
THROTTLE MASTER, ENG FLIGHT RATING and ENG RATING MODE switches; T/O - FLT and CLIMB-CRUISE
Power management panel (1-214):
ENGINE CONTROL SCHEDULE and GRD IDLE switches, Engines warning panel F/O-HI-MID-LO, diodes, caption light modules and rotary switch, FLYOVER-NORMAL-APPROACH.
NOZ AIR SOV and WIND-DOWN TEST panel (27-214):
NOZ AIR SOV and WIND-DOWN TEST switches.
Underfloor equipment bay racking (19-123 & 20-123):
Throttle reheat selected, throttle 95% and 10% relays, and diodes.
Underfloor equipment bay racking (7-123 & 8-123):
Relays P(Infinity) and N1 root theta inhibit, and diodes.
Underfloor equipment bay racking (11-123):
Relays auto contingency cont, engine speed slave, flasher unit and diode.
Underfloor equipment bay racking (2-123):
Diodes.

**ON A/C 002-006,

Rear equipment bay racking (3-243):
Relays ignition control and ignition arming, capacitor.

**ON A/C 002-007,

Rear equipment bay racking (4-243, 6-243, 4-244, 6-244):
Relay IGNITION CONTROL and IGNITION ARMING, capacitor.

For some components it is necessary to remove the associated electroluminescent (EL) panel (Ref. 33-16-00). These panels are electrically connected by flying leads or terminal connections at the back of the panel. Special tools may be required such as thin-walled tubular (hexagon or peg) spanners for switches. Cable insertion/extraction tools will be required for various cable sizes on components fitted with 'pin' type connectors. Cable looms may be temporarily moved to improve access to components. When replacing components with flying leads it is advisable to transfer connections one lead at a time from the old unit to the new.

B. Panels 2-211, 9-211 (Ref. Fig.401 and 402)

The warning panel is mounted from the front of the dash panel. The THROT captions are accessible with the centre console crate hinged back, this entails first making the droop nose safe, removing the emergency lever and centre console side panels (Ref. 76-11-12, Removal/Installation).

C. Panels 4-211, 1-214, 27-214 (Ref. Fig. 403, 404 and 405)

Switches are mounted from the rear of the panels the components being accessible with the roof or power management panels lowered onto the check cords, or for panel 27-214, released and brought forward from its aperture. Cable formers, which act as panel strengthening supports at the rear of the panels, support cable looms and terminal blocks which may restrict access to some components. These cable looms and terminal blocks may be temporarily moved to improve access to electrical components.

D. Underfloor Racking Zone 123 (Ref. Fig. 406, 407 and 408) (Ref. Fig. 409)

A number of relays, flasher units and diodes are mounted in the underfloor racking in zone 123. Sufficient cable is provided to allow each relay box to be withdrawn from the racking for individual component removal without electrically disconnecting the box from the aircraft wiring, thus subsequent test procedures require a test of only the associated circuit or component. Components within the boxes are mounted on one side of a vertical chassis with the associated wiring assembled on the reverse side.

Relay boxes 11-123, 19-123 and 20-123 do not have a side cover and direct access to components is possible. The diodes in each relay box are mounted on an insulation

board, secured to the chassis by distance pillars and protected by a diode cover. Relays are of the plug-in type, each being secured to its base by nuts, washers and screws, or by spring clamp. Diodes have terminal tags crimped to wire ends which are connected to mounting studs with securing nuts and washers.

Relay boxes 7-123, 8-123, 2-123 have top covers which must be removed for access to components.

**ON A/C 002-006,

E. Rear Equipment Racking Zone 3-243, (Ref. Fig.410 and 411) (Ref. Fig. 412)

The relays and capacitors in this area are mounted on shelf 3-243 and are accessible from the rear baggage compartment with the cover removed. It may be necessary for access, to disconnect three electrical plugs.

**ON A/C 002-007,

CAUTION: WHEN INSTALLING ELECTRICAL COMPONENTS THE TORQUE LOADING OF TERMINAL SECURING DEVICES FOR CERTAIN COMPONENTS MUST BE CARRIED OUT IN ACCORDANCE WITH 20-27-14.

ELECTROLUMINESCENT (EL) PANELS ARE SUSCEPTIBLE TO CRACKS AND SCRATCHES. ENSURE THAT TOOLS DO NOT DAMAGE THE POLISHED WALLS OF THE PANELS.

2. Electrical Components Mounted on LH Dash Panel 2-211

A. Equipment and Materials

DESCRIPTION	PART NO.
Insertion/extraction tool	-
Torq-set screwdriver	-
Circuit breaker safety clip	-

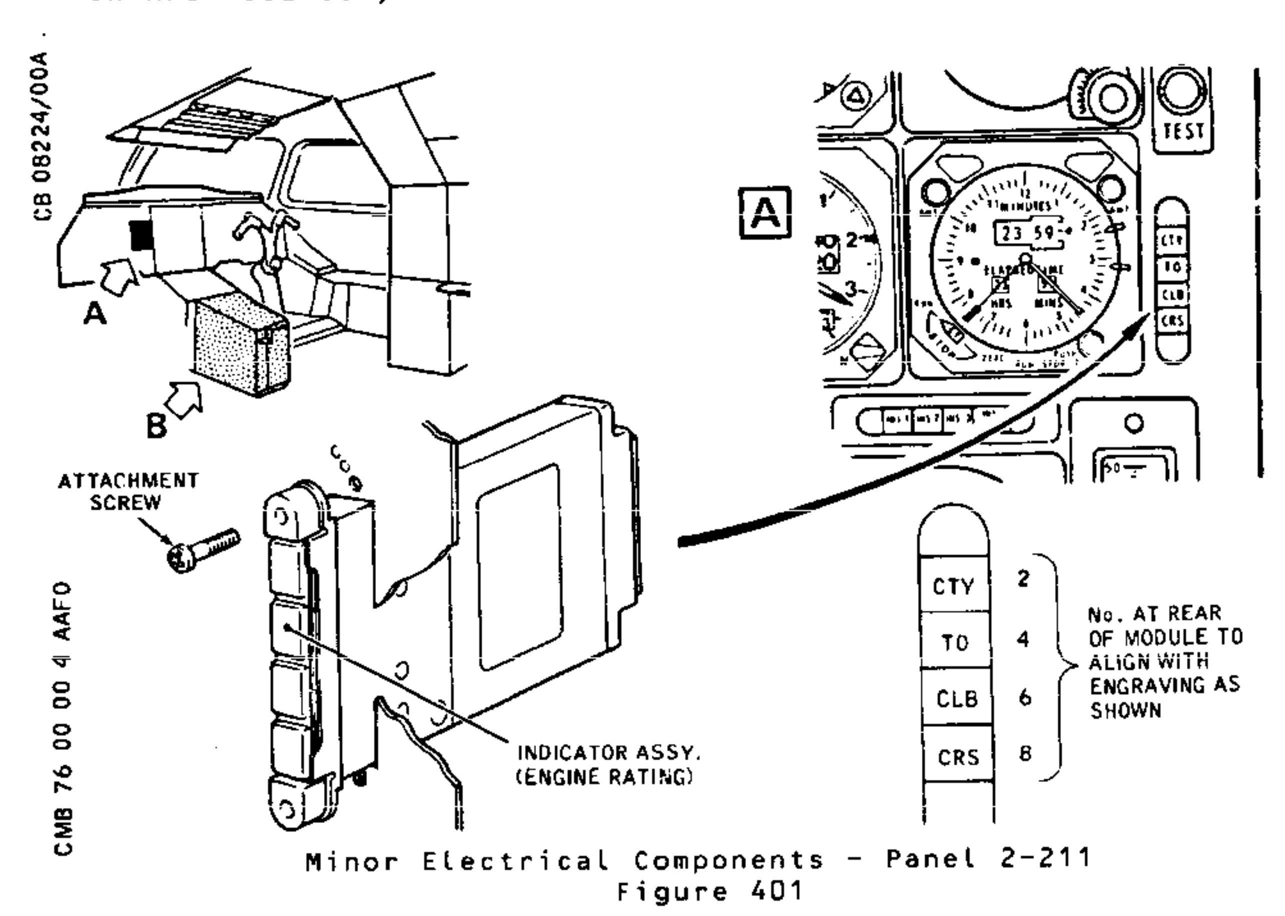
B. Prepare (Ref. Fig.401 and 402)

NOTE: On electrical components with socket type terminals the pin inserts must be disconnected and connected

in accordance with the Wiring Diagram Manual 20-42-18.

(1) Trip the RATING IND SUP circuit breaker K2300, map ref. G5 on panel 3-213 and fit a safety clip.

**ON A/C 002-007,



Minor Electrical Components - Panel 2-211
Figure 401

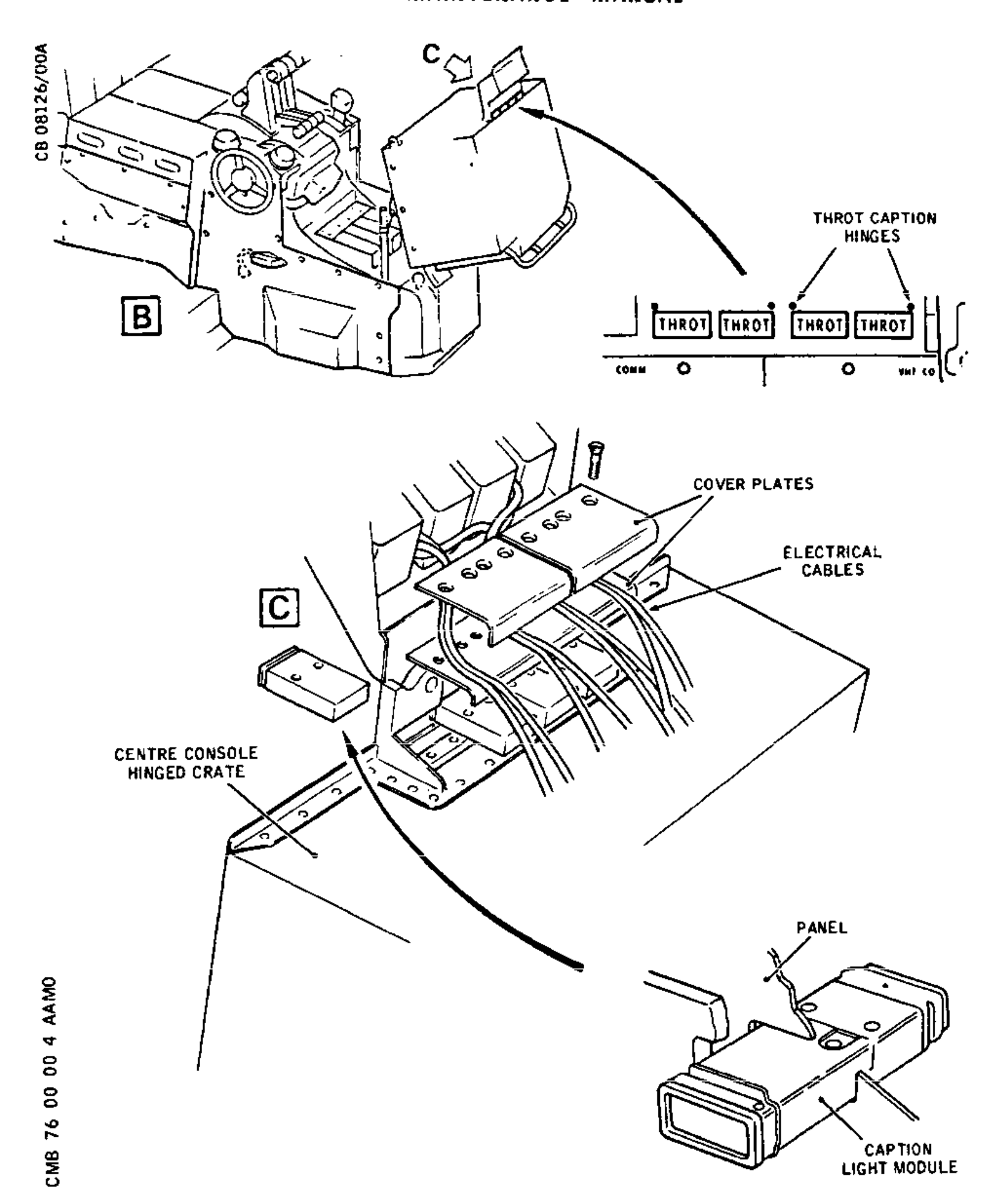
C. Remove Indicator

(1) Remove the screws and withdraw the warning indicator sufficiently to gain access to the module.

(2) Withdraw the pin inserts from the rear of the indicator.

D. Install Indicator

(1) Comply with the electrical safety precautions.



Minor Electrical Components - Panel 9-211
Figure 402

(2) Connect the electrical cables to the indicator, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Connect pin inserts in accordance with Wiring Diagram Manual 20-42-18.

CAUTION: THE NUMBERS ON THE BACK OF THE MODULE ARE TO BE ADJACENT TO THE LEGEND AS ILLUSTRATED (Ref. Fig.401 and 402).

(3) Check that the area is clean and insert the indicator into its recess in the LH dash panel and secure it with the two screws; the longer screw is to go to the top.

(4) Remove the safety clips, reset the circuit breaker RATING IND SUP K2300 map ref. G5 on panel 3-213.

(5) Carry out a test of the engine rating indication system (Ref. 76-00-00, Adjustment/Test).

3. Electrical Components Mounted on Centre Console Panel 9-211

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Insertion/extraction tool	-
Torq-set screwdriver	-
Loctite (Ref.20-30-00, No.109)	-

B. Prepare (Ref. Fig.401 and 402)

NOTE: On electrical components with socket type terminals the pin inserts must be disconnected and connected in accordance with the Wiring Diagram Manual 20-42-18.

(1) Isolate the listed circuit breakers and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1 ALTN THROT CONT	15-216	1K4	E8
ENG 2 ALTN THROT CONT	15-215	2K4	F15
ENG 3 ALTN THROT CONT	15-215	3K4	F16
ENG 4 ALTN THROT CONT	15-216	4K4	F11
ENG 1 MAIN THROT CONT	3-213	1K3	A 1
ENG 2 MAIN THROT CONT	1-213	2K3	A 3
ENG 3 MAIN THROT CONT	1-213	3K3	A 4
ENG 4 MAIN THROT CONT	3-213	4K3	A 2
ENG 1 MAIN THROT FAIL IND	1-213	1K5	A 1
ENG 2 MAIN THROT FAIL IND	3-213	2K5	A 3
ENG 3 MAIN THROT FAIL IND	3-213	3K5	A 4
ENG 4 MAIN THROT FAIL IND	1-213	4K5	A 2
ENG 1 ALT THROT FAIL IND & AJ MAX SUP	3-213	1K6	B 1
ENG 2 ALT THROT FAIL IND & AJ MAX SUP	1-213	2K6	B 3
ENG 3 ALT THROT FAIL IND & AJ MAX SUP	1-213	3K6	B 4
ENG 4 ALT THROT FAIL IND & AJ MAX SUP	3-213	4K6	B 2

(2) Make the droop nose safe, remove the emergency lever, remove the centre console side panels and hinge back the crate in accordance with 76-11-12, Removal/Installation.

C. Remove Caption

(1) Remove the screws securing the two cover plates,

remove the cover plates.

NOTE: Move the electrical cables to one side for access to the screws.

(2) Withdraw the pin inserts from the rear of the module in accordance with Wiring Diagram Manual 20-42-18.

(3) Remove the caption module from the front of the crate.

(4) Change over the filament, filter and legend from the old caption module to the new.

NOTE: A sharp instrument is needed to release the top cover.

D. Install Caption Module

(1) Comply with the electrical safety precautions.

(2) Insert the caption module through the hole from the outside of the centre console crate. Ensure that the white painted line on the inside of the crate and the hinged edge of the module are aligned (Ref. Fig.401 and 402) and that the module is seated in its recess.

(3) Connect the electrical cables to the module, ensuring that the connections are made in accordance with the cable identifications and the applicable Wiring Diagram Manual. Connect pin inserts in accordance with Wiring Diagram Manual, (20-42-18).

(4) Secure the module in place by fitting the two covers and securing them with the screws. Smear a small amount of loctite on the thread of each screw before tightening.

(5) Carry out a test on the THROT Caption (Ref. 76-00-00, Adjustment/Test). Check that the area is clean, close and lock the hinged crate and secure the side panels (Ref. 76-11-12, Removal/Installation).

4. Electrical Components Mounted on Panel 4-211

A. Equipment and Materials

DESCRIPTION	PART NO.
Insertion/extraction tool	-
Torq-set screwdriver	-
Thin-wall tubular spanner	-

B. Prepare (Ref. Fig. 403)

NOTE: On electrical components with socket type terminals the pin inserts must be disconnected and connected in accordance with the Wiring Diagram Manual 20-42-18.

(1) Isolate the electrical generation and external power in accordance with 24-00-00, Servicing.

(2) Release the quick-release fasteners securing panel 4-211 and permit the panel to hang down on the restraint cords.

(3) If necessary, remove the EL panel (Ref. 33-16-00).

C. Remove Toggle Switch

(1) If necessary release the cable loom ties to gain access.

(2) Using the insertion/extraction tool, withdraw the pin inserts from the rear of the switch.

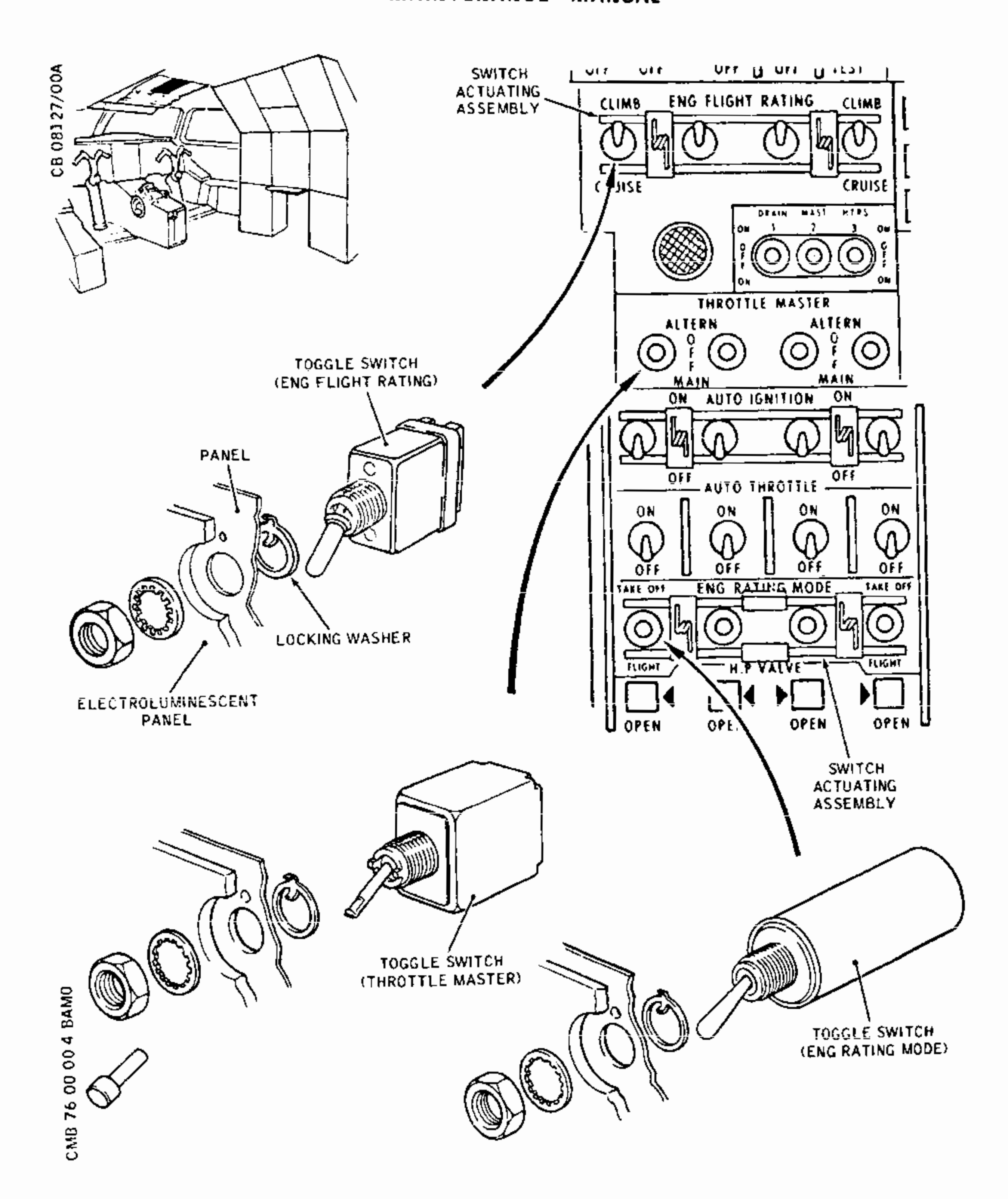
NOTE: If possible, change the lead connections over one at a time from the old switch module to the new, in accordance with the cable identification and the relevant Wiring Diagram Manual.

(3) Using a thin-walled tubular spanner, remove the nut and washer from the front of the panel; withdraw the switch and locating washer from the panel rear.

D. Install Toggle Switch

(1) Comply with the electrical safety precautions.

(2) Position the locating washer on the switch and insert the switch through the opening from the panel



Minor Electrical Components, Panel 4-211
Figure 403

rear; ensure that the lug on the washer engages the locating hole in the panel.

(3) Secure the switch with the nut and washer.

(4) Connect/check the electrical cables to the switch, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Connect pin inserts (Ref. 20-42-18).

(5) Replace if necessary the EL panel (Ref. 33-16-00).

F. Conclusion.

(1) Check that the area is clean, close the panel and secure it with the quick release fasteners.

(2) Make available electrical ground power (Ref. 24-41-00).

(3) Carry out an operational test on the THROTTLE MASTER switch (Ref. 76-00-00, Adjustment/Test). ENG FLIGHT RATING AND ENG RATING MODE switches are to be functionally tested (Ref. 76-11-00, Adjustment/Test).

5. Electrical Components Mounted on Panel 1-214

A. Equipment and Materials

DESCRIPTION	PART NO.
Insertion/extraction tool	-
Thin-walled tubular spanners	-
Torq-set screwdriver	-
Extractor, caption modules	-

B. Prepare (Ref. Fig. 404)

NOTE: On electrical components with socket-type terminals the pin inserts must be disconnected and connected in accordance with the Wiring Diagram Manual 20-42-18.

(1) Isolate the electrical generation and external power (Ref. 24-00-00, Servicing).

(2) Remove, if necessary, the electroluminescent panel (Ref. 33-16-00).

(3) Loosen the quick-release fasteners securing the panel, press in the spring retaining clip and lower the panel on its hinges to the extent of the check cords.

C. Remove Toggle Switch

(1) Release, if necessary, the cable loom ties for access to the terminals at the rear of the switch module.

(2) Withdraw the pin inserts from the rear of the switch (Ref. Wiring Diagram Manual, 20-42-18).

(3) Using a tubular spanner, remove the nut and washer from the front of the panel; withdraw the switch and tab washer from the panel rear.

D. Install Toggle Switch

(1) Comply with the electrical safety precautions.

(2) Position the tab-washer on the switch and insert the switch through the opening from the panel rear; ensure that the lug on the tab washer engages the locating hole in the panel.

(3) Secure the switch with the nut and washer.

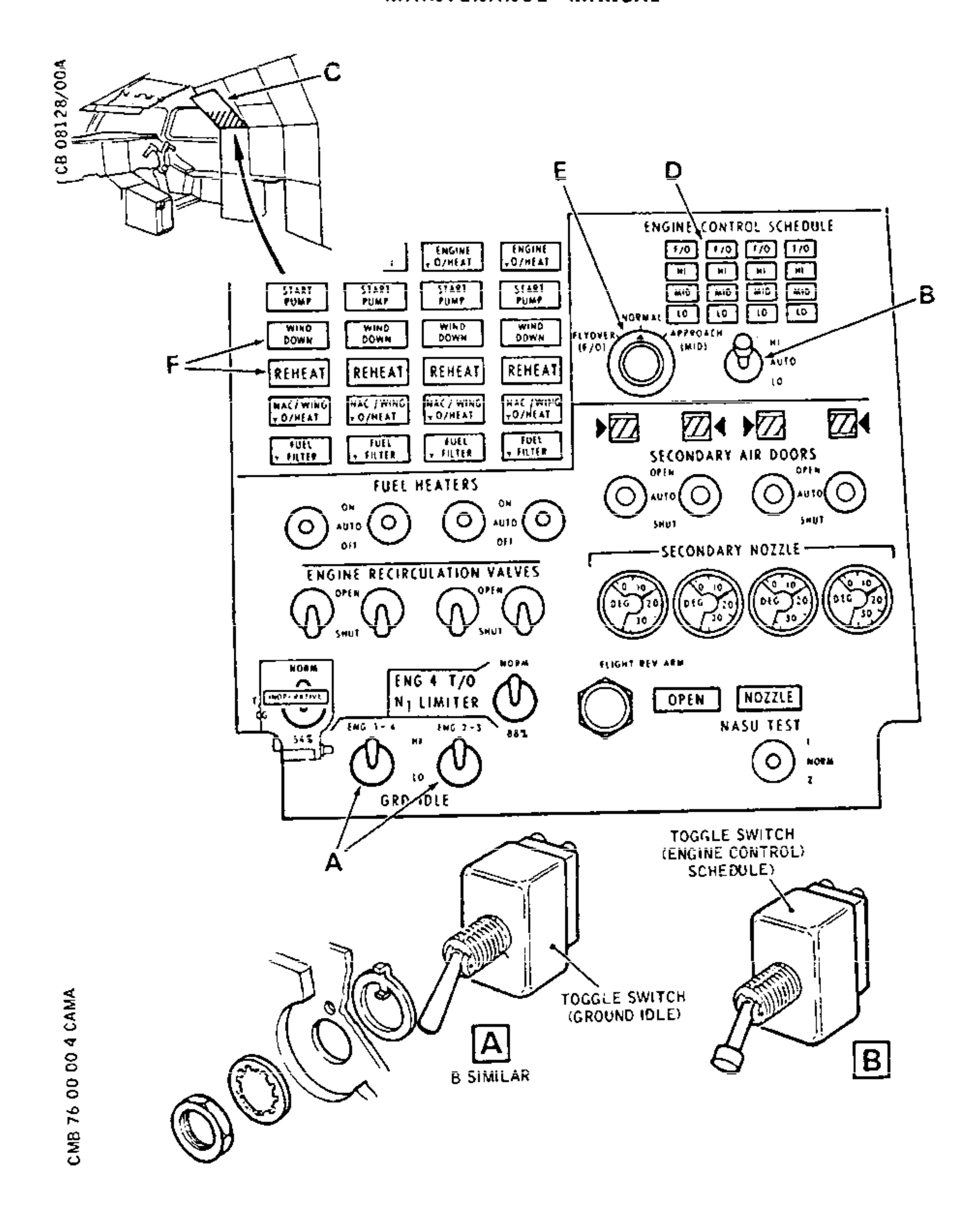
(4) Connect the electrical cables to the switch, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Connect pin inserts (Ref. Wiring Diagram Manual, 20-42-18).

(5) Secure, if necessary, the cable loom ties removed for access.

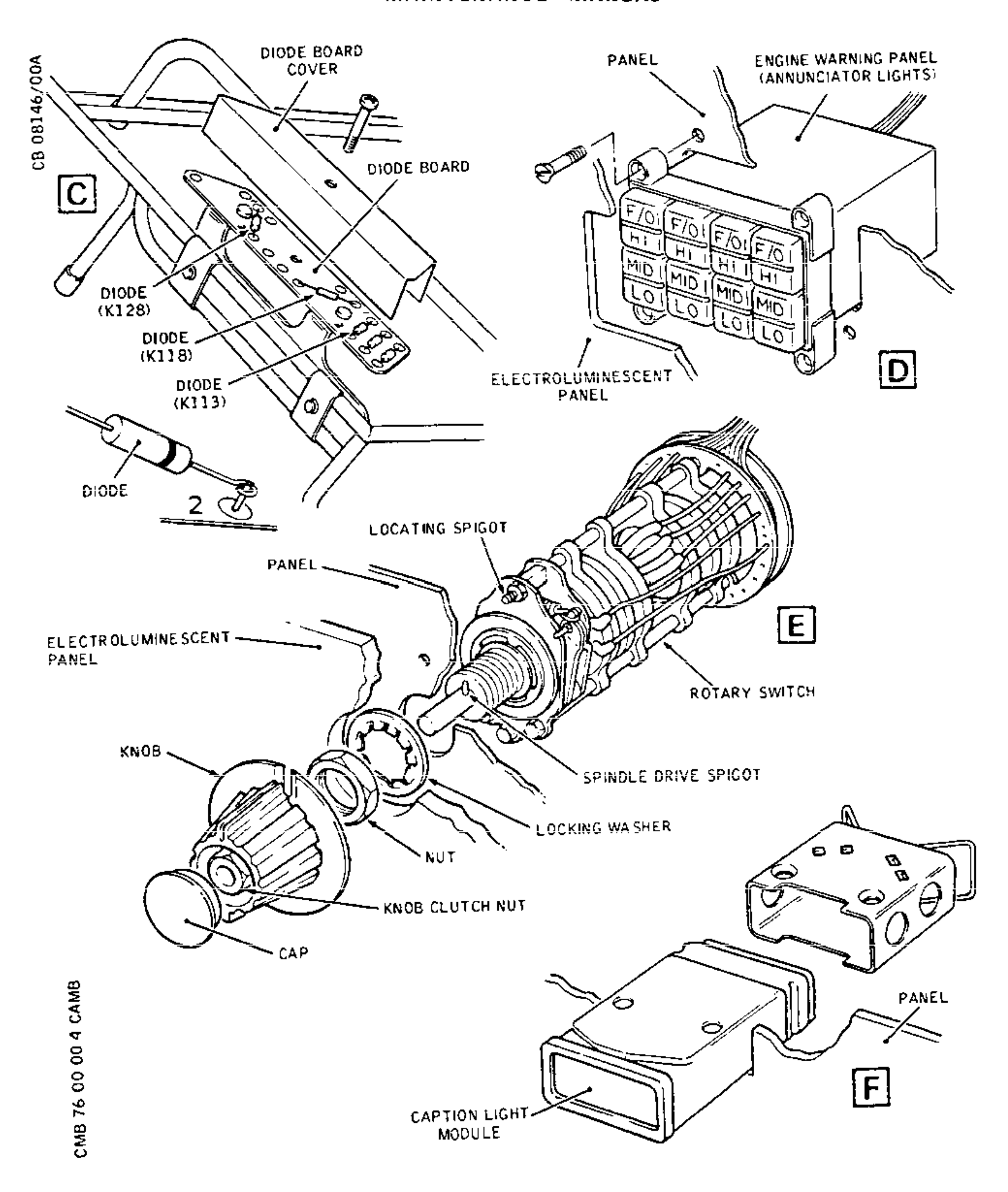
(6) Carry out an operational test on the E Schedule switch (Ref. 76-00-00, Adjustment/Test). The ground idle switch is to be functionally tested (Ref. 76-11-00, Adjustment/Test).

E. Remove Engine Warning Panel (Annunciator Lights)

(1) Remove the EL panel (Ref.33-16-00) covering the



Minor Electrical Components - Panels
1-214 (Sheet 1 of 2)
Figure 404



Minor Electrical Components - Panels
1-214 (Sheet 2 of 2)
Figure 404

ENGINE CONTROL SCHEDULE annunciators.

(2) At the panel rear remove cable loom ties for access.

(3) At the panel rear using the insertion/extraction tool, disconnect the flying leads from the light module (see note in para 1, General about disconnecting/connecting components).

(4) From the panel front remove the four screws securing the light module, remove the module from the rear.

F. Install Engine Warning Panel (Annunciator Lights)

(1) Comply with the electrical safety precautions.

(2) Engage the light module with the panel from the rear, and secure with the screws.

(3) Using the insertion/extraction tool connect the flying leads in accordance with the cable identification and the applicable Wiring Diagram Manual. Connect pin inserts (Ref. Wiring Diagram Manual, 20-42-18).

(4) Secure the cable loom ties including any removed for access.

(5) Carry out a test on the E Schedule Annunicator Lights (Ref. 76-00-00, Adjustment/Test).

G. Remove Diode (Ref. Fig. 404)

(1) Move, if necessary, the cables to gain access to the diode board.

(2) At the rear of panel remove cover screw and diode board cover.

(3) Unsolder the diode wire ends from the insulation barbs and remove the diode from the board.

H. Install Diode

NOTE: Solder diodes (Ref. Wiring Diagram Manual, 20-42-23).

(1) Comply with electrical safety precautions.

(2) Position the replacement diode with the black ring on the cathode end of the diode pointing

to terminal 2 on the board. Solder the wire ends to the associated barbs in accordance with the Wiring Diagram Manual 20-42-23.

(3) Replace the diode board cover and secure it with the cover screw.

(4) Replace, if necessary, cable ties on cables which were moved for access.

(5) Carry out an Operational Test on Engine Control (E) Schedule Annunciators (Ref. 76-00-00, Adjustment/Test).

J. Remove Caption Module (Ref. Fig. 404)

(1) If necessary, release the cable loom ties for access to the terminals at the rear of the caption light module.

(2) Withdraw pin inserts from the rear of the module (Ref. Wiring Diagram Manual, 20-42-18).

(3) Using the extraction tool disengage the clamp retaining springs at the rear of the module and remove the module from the front of the panel and the clamp from the rear.

(4) Change over the legend, filter and filament from the old unit to the new.

K. Install Caption Module

(1) Comply with the electrical safety precautions.

(2) Position the clamp on the rear of the panel and insert the caption light module through the hole from the front. Ensure that the white painted line on the back of the panel and the hinged edge of the module are in alignment, and that the clamp is aligned symmetrically with the module.

(3) Hold the module firmly against the panel front and simultaneously press the clamp into position from the rear, until the retaining spring engages with the recesses in the module body.

(4) Connect the electrical cables to the module, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Connect pin inserts to the module in

accordance with Wiring Diagram Manual, 20-42-18.

(5) Secure the cable loom ties, as necessary, in accordance with 20-27-15.

(6) Carry out an Operational Test on Engine Control (E) Schedule Annunciators (Ref. 76-00-00, Adjustment/ Test).

L. Remove Rotary Switch

(1) Release the flying leads from the loom ties and withdraw the pin inserts from the module block.

(2) Remove the cap from the end of the switch knob, loosen the clutch nut and withdraw the knob from the switch spindle.

(3) Using a tubular spanner, remove the nut and washer from the front of the panel and withdraw the switch from the rear.

M. Install Rotary Switch.

(1) Comply with the electrical safety precautions.

(2) Insert the switch through the aperture from the rear of the panel, ensuring that the locating spigot engages with the locating hole in the panel.

(3) Secure the switch with the nut and washer.

(4) Fit the knob on the switch spindle, ensuring that the spindle spigot is engaged with the slot in the knob. Tighten the clutch nut and fit the end cap.

(5) Connect the flying leads to the module block, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram manual.

(6) Secure the flying leads to the cable loom with suitable ties in accordance with 20-27-15.

(7) Carry out an Operational test on NASU and E Schedule (Ref. 76-00-00).

6. Electrical Components Mounted on Panel 27-214

A. Equipment and Materials.

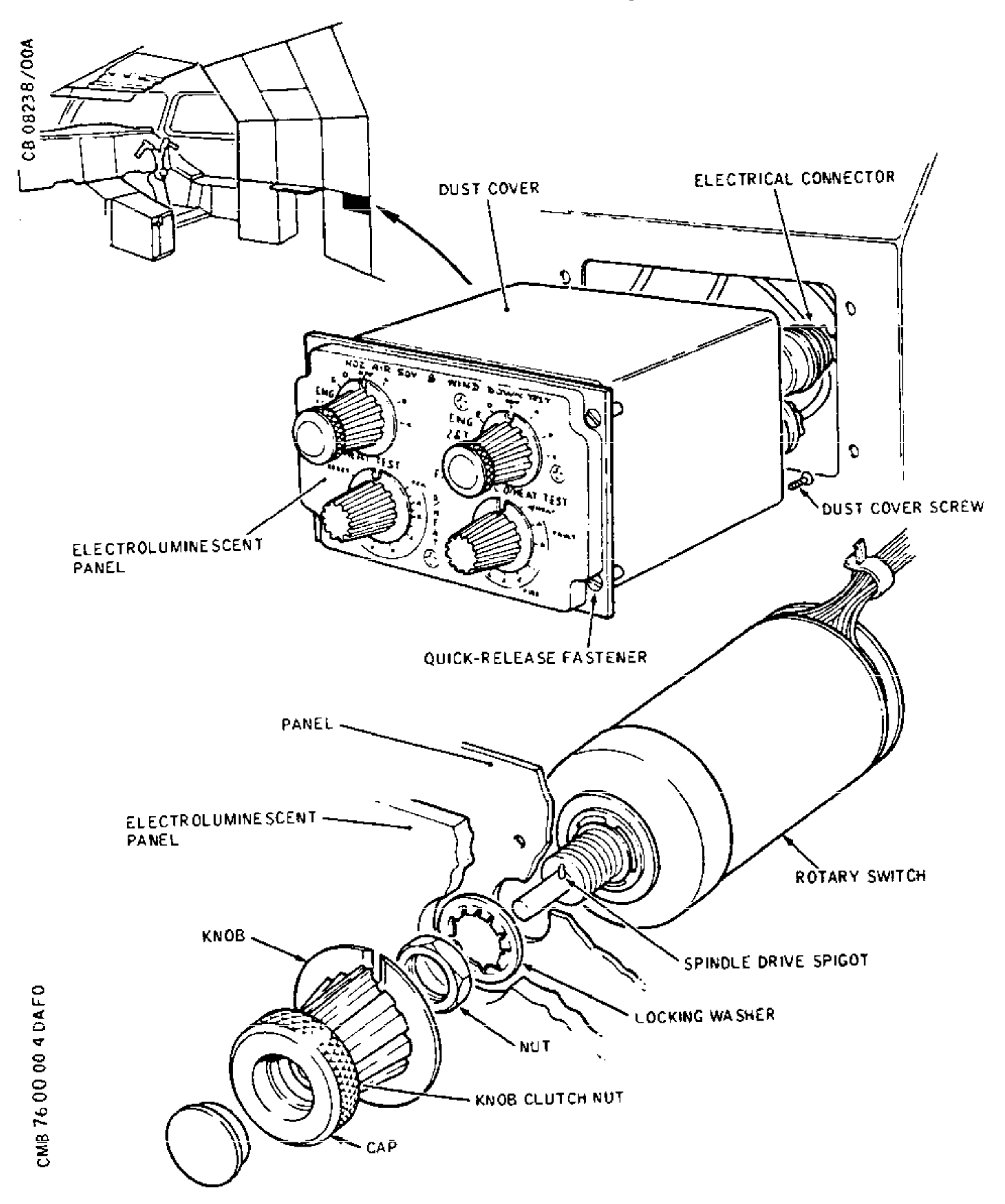
DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torq-set screwdriver	-
Tubular spanner	-
Insertion/Extraction tool	-

B. Prepare (Ref. Fig. 405)

(1) Electrically isolate the panel by tripping the circuit breakers listed. Fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1 WIND DOWN CONT SUP 2	1-213	1K1108	C7
ENG 4 WIND DOWN CONT SUP 2		4K1108	C8
ENG 2 WIND DOWN CONT SUP 1		2K1101	F4
ENG 3 WIND DOWN CONT SUP 1		3K1101	F5
ENG 1 WIND DOWN CONT SUP 1	5-213	1K1101	B1
ENG 4 WIND DOWN CONT SUP 1		4K1101	B2
ENG 2 WIND DOWN CONT SUP 2		2K1108	C1
ENG 3 WIND DOWN CONT SUP 2		3K1108	C2
ENG 2 REV BUCKET POSN IND	1-213	2E121	B7
ENG 3 REV BUCKET POSN IND		3E121	B8
ENG 1 REV BUCKET POSN IND	5-213	1E121	A3
ENG 4 REV BUCKET POSN IND		4E121	A4
ENG 1 INT O/HEAT IND	4-213	1E171	D19
ENG 2 INT O/HEAT IND		2E171	B18
ENG 3 INT O/HEAT IND		3E171	B19
ENG 4 INT O/HEAT IND		4E171	D20
ENG 1 REV THRUST ASOV CONT	3-213	1K334	G3
ENG 2 REV THRUST ASOV CONT	1-213	2K334	D7
ENG 3 REV THRUST ASOV CONT	1-213	3K334	D8
ENG 4 REV THRUST ASOV CONT	3-213	4K334	G4
ENG FIRE & O/HEAT TEST SUP	15-215	W431	B1

(2) Release the quick-release fasteners and withdraw the panel to gain access to the electrical



Minor Electrical Components Panel 27-214
Figure 405

connectors at the rear of the panel. Disconnect the connectors and remove the panel from the structure.

(3) Remove the screws from the rear of the panel and withdraw the dust cover from the panel.

C. Remove Typical Rotary Switch

CAUTION: ELECTROLUMINESCENT PANELS ARE VULNERABLE TO DAMAGE BY SCRATCHING AND CRACKING. ENSURE THAT TUBULAR SPANNERS DO NOT DAMAGE THE POLISHED WALL OF THE PANEL CUT-OUTS.

(1) Label the cables, as necessary, and release the cables (flying leads) from the associated loom ties and, using an insertion/extraction tool, withdraw the pin inserts from the connector.

(2) Remove the cap from the end of the knob, unscrew the clutch nut and withdraw the knob from the switch spindle.

(3) Using a suitable tubular spanner, remove the nut and locking washer and withdraw the switch from the rear of the panel.

D. Install Typical Rotary Switch

(1) Comply with the electrical safety precautions.

(2) Position the switch through its aperture, from the rear of the panel, ensuring that the locating spigot engages the hole in the panel.

(3) Fit the locking washer and nut.

(4) Fit the knob on the switch spindle, ensuring that the spindle drive spigot is engaged with the slot in the knob. Tighten the clutch nut and fit the end cap.

(5) Using an insertion/extraction tool, connect the electrical cables to the connector, ensuring that the connections are made in accordance with the cable identifications/labels: remove the identifying labels previously applied.

(6) Secure the electrical cables to the cable loom with suitable ties in accordance with 20-27-15.

**ON A/C 002-006,

R B (7) When removing/installing the "NOZ AIR SOV and
R B WIND DOWN TEST switches" make an entry in the
R B Aircraft Technical Report (Sector Defect Log)
R B that a secondary nozzle ASOV check must be
R B carried out on departure from that station/base.

**ON A/C 002-007,

E. Conclusion.

(1) Fit the dust cover and secure it with the screws.

(2) Connect the electrical connectors to the connectors on the panel, ensuring that the mating surfaces are clean and undamaged.

(3) Insert the panel into the structure and secure it with the quick-release fasteners. Check that the panel is electrically bonded in accordance with 20-27-11.

(4) Carry out a test on the NOZ AIR SOV and WIND DOWN switch (Ref. 78-00-00, Adjustment/Test).

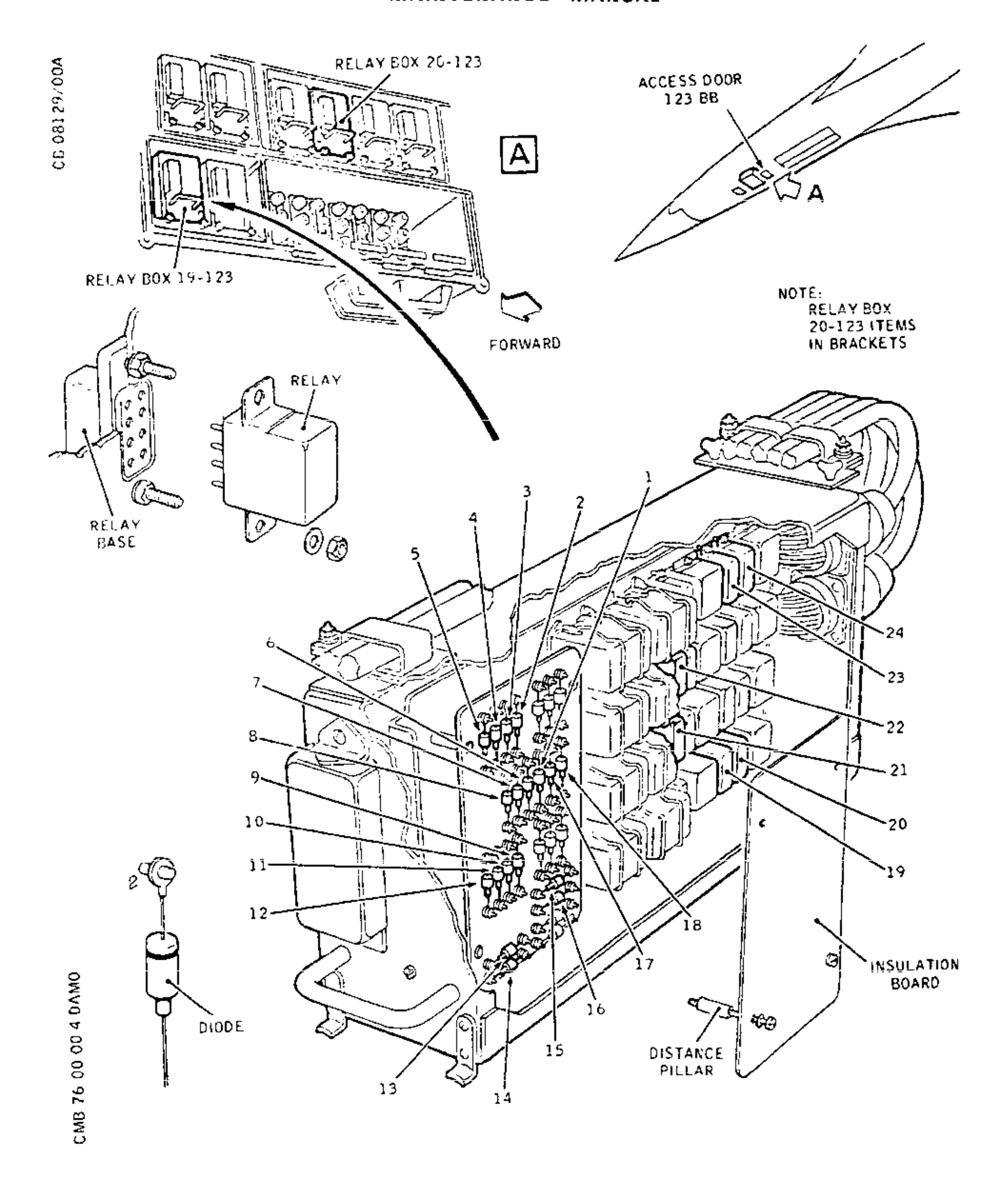
7. Electrical Components Mounted in Racking 19-123 & 20-123 7-123, 8-123, 11-123 and 2-123

A. Equipment and Materials

DESCRIPTION	PART NO.
Torq-set screwdriver	MS 33781

B. Prepare (Ref. Fig. 406, 407 and 408) (Ref. Fig. 409)

(1) Isolate the electrical generation and external power in accordance with 24-00-00, Servicing.



Minor Electrical Components Relay Box
19-123, 20-123
Figure 406

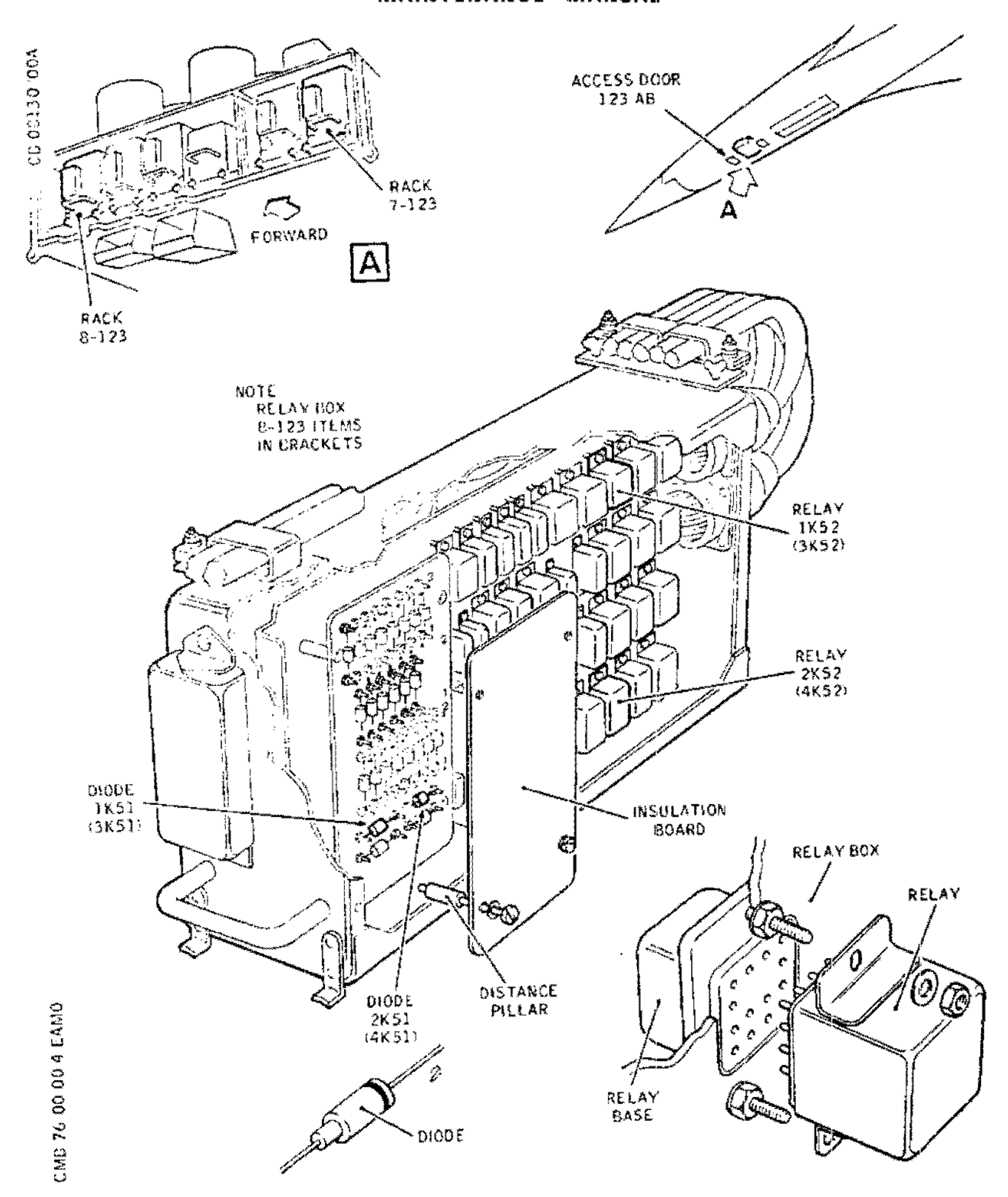
MINOR ELECTRICAL COMPONENTS

KEY NO.	ENGINE RELAY BOX 19-123	ELECT. IDENT.	ENGINE RELAY BOX 20-123	ELECT. IDENT.
1	Diode- ENG 2	2K2308	Diode- ENG 4	4K2308
2	Diode- ENG 1	1K16	Diode- ENG 3	3K2308
3	Diode- ENG 1	1K15	Diode- ENG 3	3K15
4	Diode- ENG 1	1K14	Diode- ENG 3	3K14
5	Diode- ENG 1	1K13	Diode- ENG 3	3K13
6	Diode- ENG 1	1K2308	Diode- ENG 3	3K2308
7	Diode- ENG 2	2K1129	Diode- ENG 4	4K1129
8	Diode- ENG 1	1K1129	Diode- ENG 3	3K1129
9	Diode- ENG 2	2K16	Diode- ENG 4	4K16
10	Diode- ENG 2	2K15	Diode- ENG 4	4K15
11	Diode- ENG 2	2K14	Diode- ENG 4	4K14
12	Diode- ENG 2	2K13	Diode- ENG 4	4K13
13	Diode- ENG 1	1K2342	Diode- ENG 3	3K2342
14	Diode- ENG 2	2K2342	Diode- ENG 4	4K2342
15	Diode- ENG 1	1K119	Diode- ENG 3	3K119
16	Diode- ENG 2	2K119	Diode- ENG 4	4K119
17	Diode- ENG 1	1K2309	Diode- ENG 3	3K2309
18	Diode- ENG 2	2K2309	Diode- ENG 4	4K2309
19	Relay- throttle 10% ENG 2	2K727	Relay- throttle 10% ENG 4	4K727
20	Relay- 95% ENG 2	2K1125	Relay- 95% ENG 4	4K1125
21	Relay- reheat selected ENG 2	2K1565	Relay- reheat selected ENG 4	4K1565
22	Relay- reheat selected ENG 1	1K1565	Relay- reheat selected ENG 3	3K1565
23	Relay- throttle 10% ENG 1	1K727	Relay- throttle 10% ENG 3	3K727
24	Relay- 95% ENG 1	1K1125	Relay- 95% ENG 3	3K1125

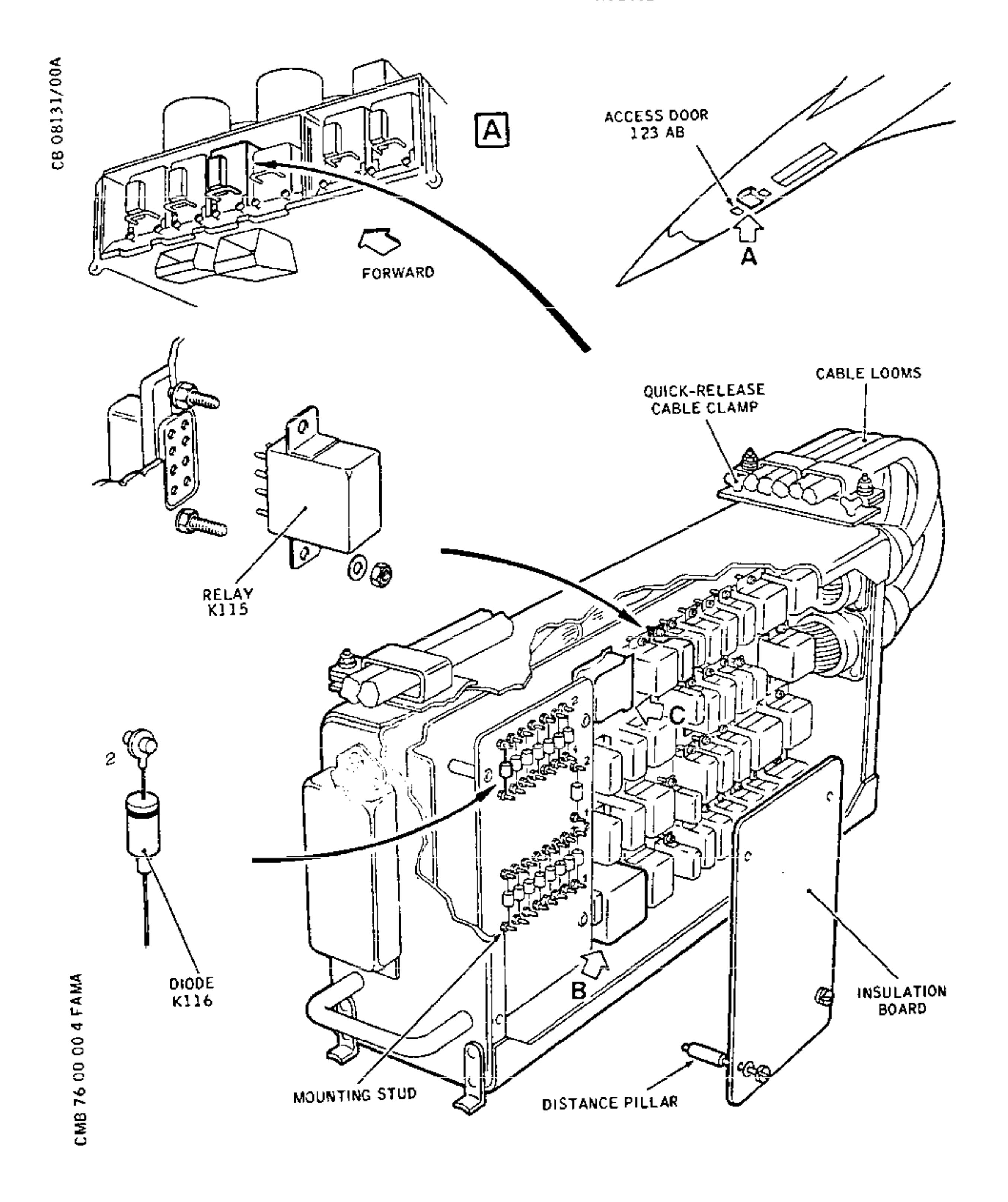
(2) Open the service compartment door 123 BB (Ref. 54-41-11) to gain access to LH and RH engine relay boxes 19-123, 20-123 or to miscellaneous relay boxes 11-123, 7-123, 8-123 and 2-123

(3) Release the hold-down fasteners from the appropriate engine or miscellaneous relay box hold down hooks.

(4) Withdraw the panel from the rack sufficiently to gain access to the quick-release cable clamps on top of the box.

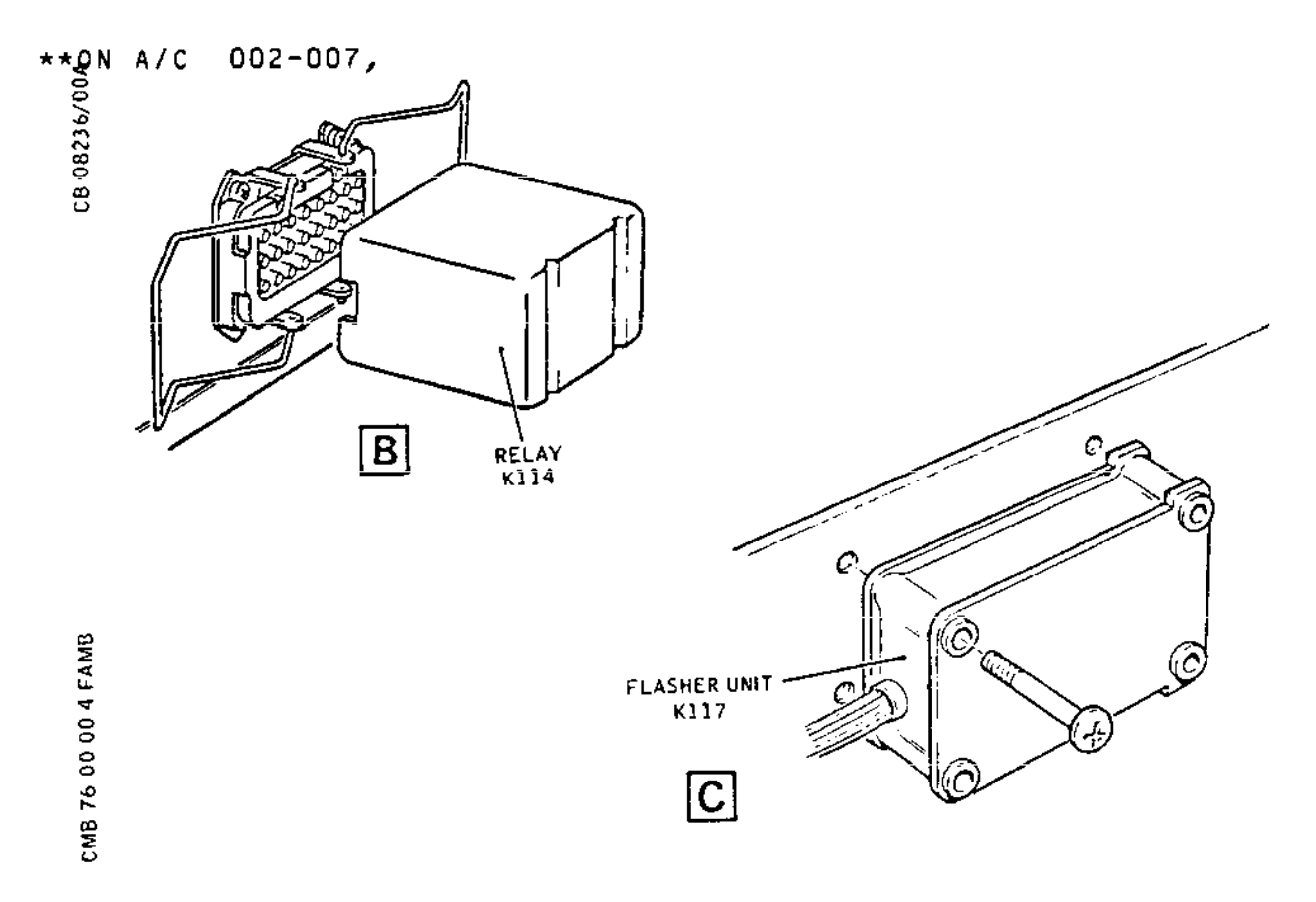


Minor Electrical Components Relay Box
7-123, 8-123
Figure 407



Minor Electrical Components Relay Box 11-123
Figure 408

**ON A/C 002-007,



Minor Electrical Components Relay Box 11-123
Figure 408

(5) Release the cable clamps to detach the cables from the top of the box.

(6) Move the box clear of the rack and lower it onto a suitable support.

(7) Remove the screws and washers securing the back cover of relay boxes, 7-123, 8-123, 2-123.

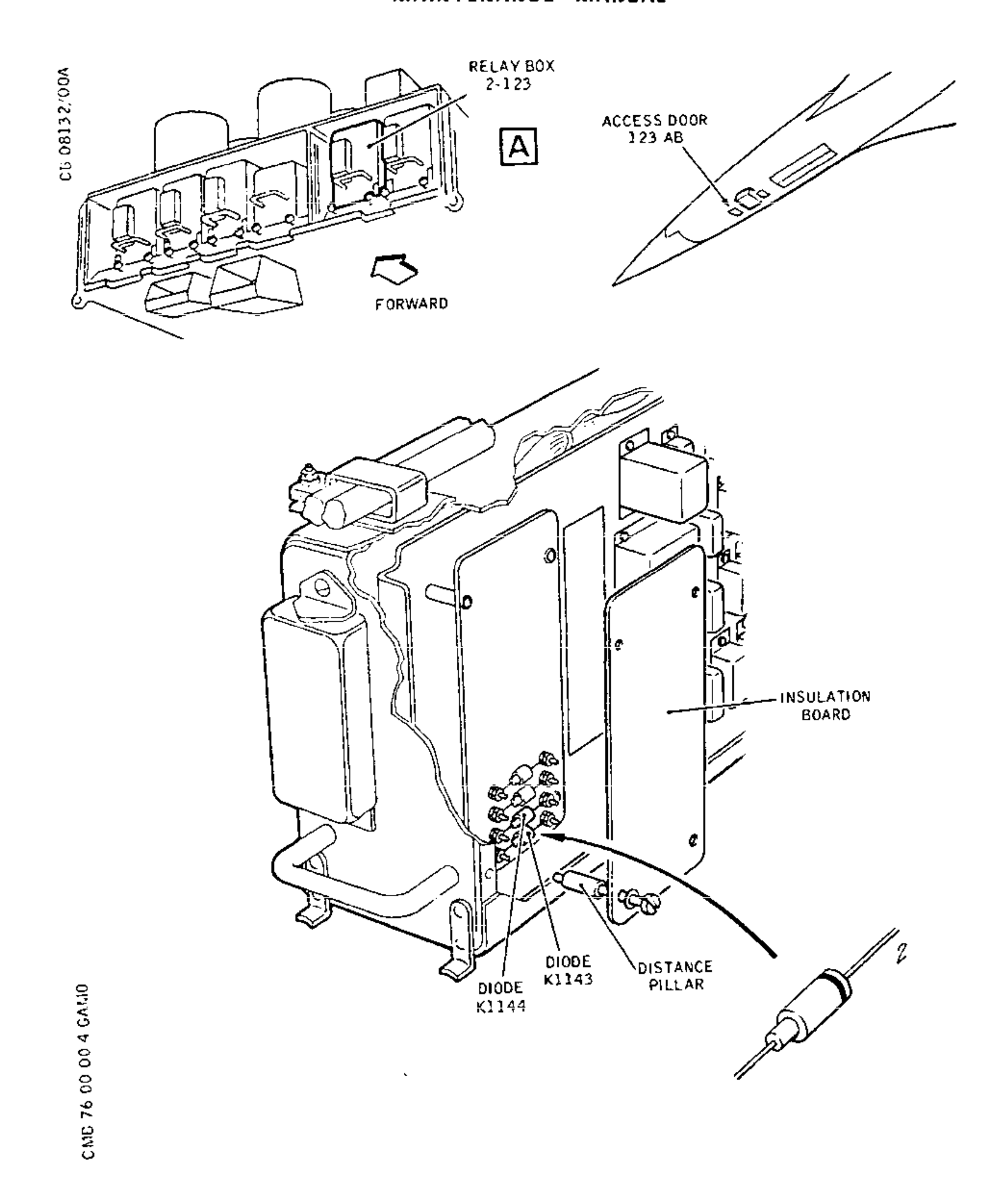
C. Remove Flasher Unit.

(1) If necessary remove cable loom ties to gain access.

(2) Identify the appropriate flasher unit and release its flying leads from the module blocks.

(3) Remove the screws securing the flasher unit, remove the unit.

D. Install Flasher Unit



Minor Electrical Components Relay Box 2-123
Figure 409

(1) Comply with the electrical safety precautions.

(2) On the relay box engage the flasher unit with the relay box and secure it in position with screws and washers.

(3) Torque tighten the screws using the Torq-set screwdriver.

(4) Secure the flying leads from the flasher unit in accordance with the cable identification and the applicable Wiring Diagram Manual Chapter. Secure the end fittings in accordance with the relevant Wiring Diagram Manual Chapter.

(5) Replace cable loom ties which may have been disturbed.

(6) Carry out Conclusion para J.

(7) Carry out the functional test (Ref. 76-00-00, Adjustment/Test).

E. Remove Relay

(1) Remove the nuts and washers or the spring clamp, as applicable, securing the relay to its mounting base and withdraw the relay from its socket.

F. Install Relay

(1) Comply with the electrical safety precautions.

(2) Check that the relay pins are clean and undamaged.

NOTE: Operation (3) is necessary only if one of the named relays is being refitted.

(3) On 'half crystal can size' relays (1K0234, 2K0234, 3K0234, 4K0234) check that the mounting lugs are at 90 deg to the relay body. Re-align the lugs as necessary.

(4) Align the locating pin on the relay body with the locating hole in the relay mounting base and plug the relay into the socket.

(5) Secure the relay body to the mounting base with the nuts and washers, or the spring clamp, as applicable.

(6) Carry out the relevant test (Ref. 76-00-00,

Adjustment/Test); with the exception of relays Poo & N1 root theta inhibit which are tested in accordance with 76-11-00.

(7) Carry out Conclusion Para J.

G. Remove Diode.

(1) Remove the screws securing the diode board cover to the distance pillars and remove the cover from the diode board.

(2) Disconnect the diode from the mounting studs and removed the diode from the board.

H. Install Diode

(1) Comply with the electrical safety precautions.

NOTE: If the replacement diode does not have tags fitted to wire ends, the terminal tags must be crimped to the ends in accordance with the Wiring Diagram Manual, 20-21-01. Tags for diodes are pin 1, Solid Strand and AMP 34105, and Pin 2, Solid Strand 34104-T006-02.

(2) Position the replacement diode so that the black ring on the cathode end is pointing to terminal 2 on the diode board. Secure the tags to the mounting studs with the nuts and washers. On size 6 stud, torque-tighten the terminal nut to 0.5 lbf in (0.056 mdaN).

(3) Check that the area is clean and refit the diode board cover to the distance pillars. Secure it with the screws.

J. Conclusion

(1) Replace the back cover on relay boxes 7-123, 8-123, 2-123 and secure with screws and washers, torque-tighten the screws to between 12 to 15 lbf in (0.14 - 0.17 mdaN).

(2) Mount the relay box on the end of the rack support rails and secure the cables to the top of the panel with the quick-release cable clamps.

(3) Slide the box into the racking and secure it with the hold down fasteners.

(4) Check that the relay box is bonded in accordance with 20-27-11.

(5) Cancel the electrical safety precautions and check the operation of the components by carrying out the appropriate test.

(6) Check that the area is clean and lock the service compartment door 123 BB (Ref.52-42-11).

8. Electronic Components Mounted in Racking 7-243, 7-244

A. Equipment and Materials

DESCRIPTION	PART NO.
Torq-set screwdriver	MS 33781
Circuit breaker safety clips	-

**ON A/C 002-006,

B. Prepare (Ref. Fig.410 and 411)

(1) Trip the appropriate circuit breakers and fit safety clips.

**ON A/C 002-007,

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No.1			
ENG 1 AMP SUP	14-215	1K1541	C12
ENG 1 REHEAT IGNITION SUP PHA		1K1543	B13
ENG 1 REHEAT IGNITION SUP PHC		1K1544	F12
ENG 1 REHEAT CONT	15-216	1K1542	E 9
Engine No.2			
ENG 2 REHEAT CONT	15-215	2K1542	D15
ENG 2 REHEAT AMP SUP	13-215	2K1541	B14
ENG 2 REHEAT IGNITION SUP PHA	13-215	2K1543	A14
ENG 2 REHEAT IGNITION SUP PHC		2K1544	E14
Engine No.3			
ENG 3 REHEAT CONT	15-215	3K1542	D16

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 3 REHEAT AMP SUP	13-216	3K1541	B 7
ENG 3 REHEAT IGNITION PHA		3K1543	A 5
ENG 3 REHEAT IGNITION PHC		3K1544	F 6
Engine No.4			
ENG 4 REHEAT CONT	15-216	4K1542	E10
ENG 4 REHEAT AMP SUP	14-216	4K1541	D 7
ENG 4 REHEAT IGNITION SUP PHA		4K1543	A 6
ENG 4 REHEAT IGNITION SUP PHC		4K1544	E 7

4-244

(2) Enter the rear baggage compartment and walk forward for access to LH and RH racking.

(3) Remove the cover from the appropriate LH or RH racking 4-243 or 4-244.

C. Remove Relay

NOTE: It should be possible to remove a relay(s) from the shelves without disturbing cable plug connections. If, however, plugs are to be removed for access, first isolate ground electrical services (Ref.24-00-00, Servicing).

(1) Locate the shelf and the required relay; IGNITION ARMING or IGNITION CONTROL.

(2) Release the spring clamp securing the relay to its mounting base; withdraw the relay from the socket.

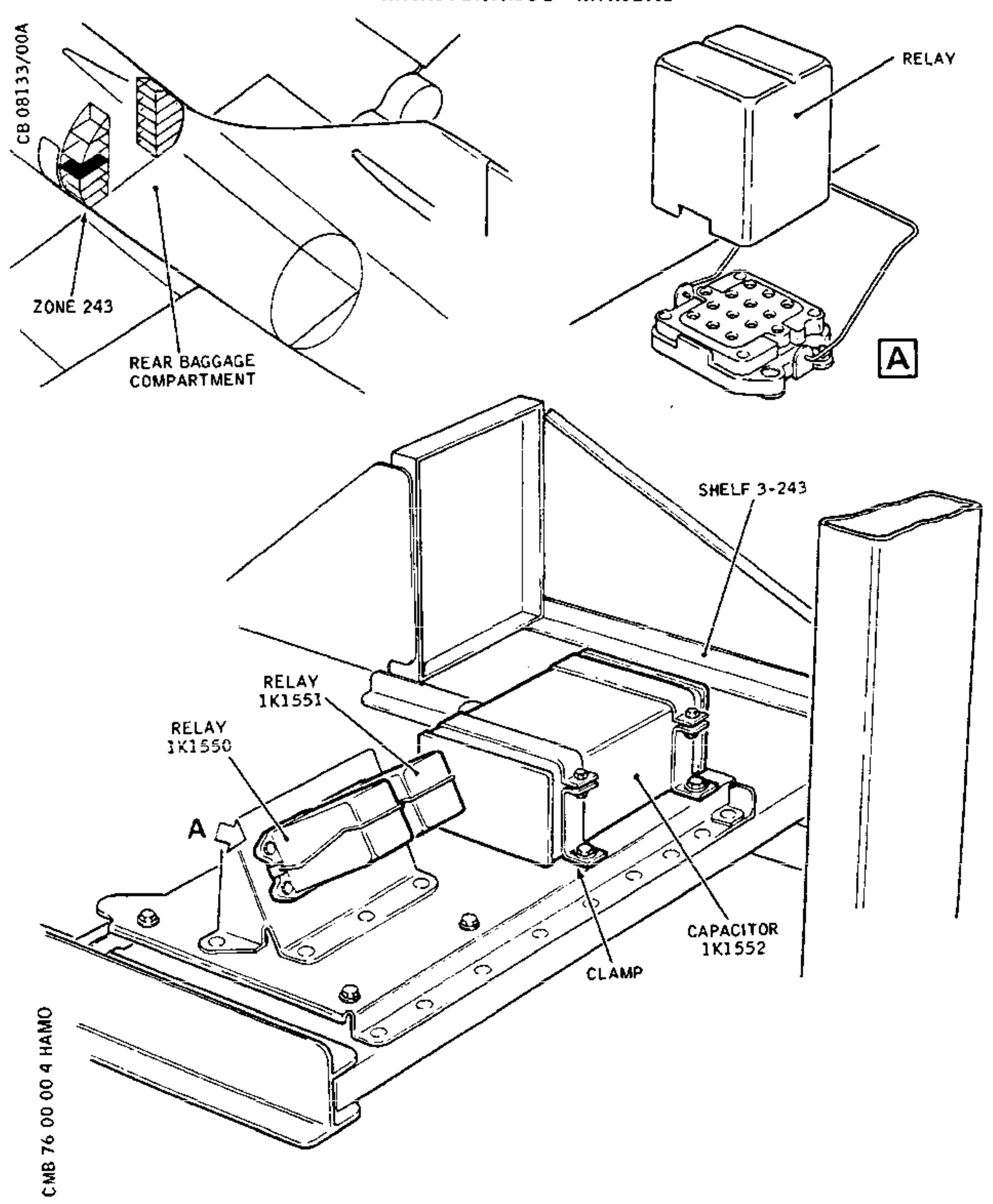
D. Install Relay (Ref. Fig. 412)

(1) Comply with the electrical safety precautions.

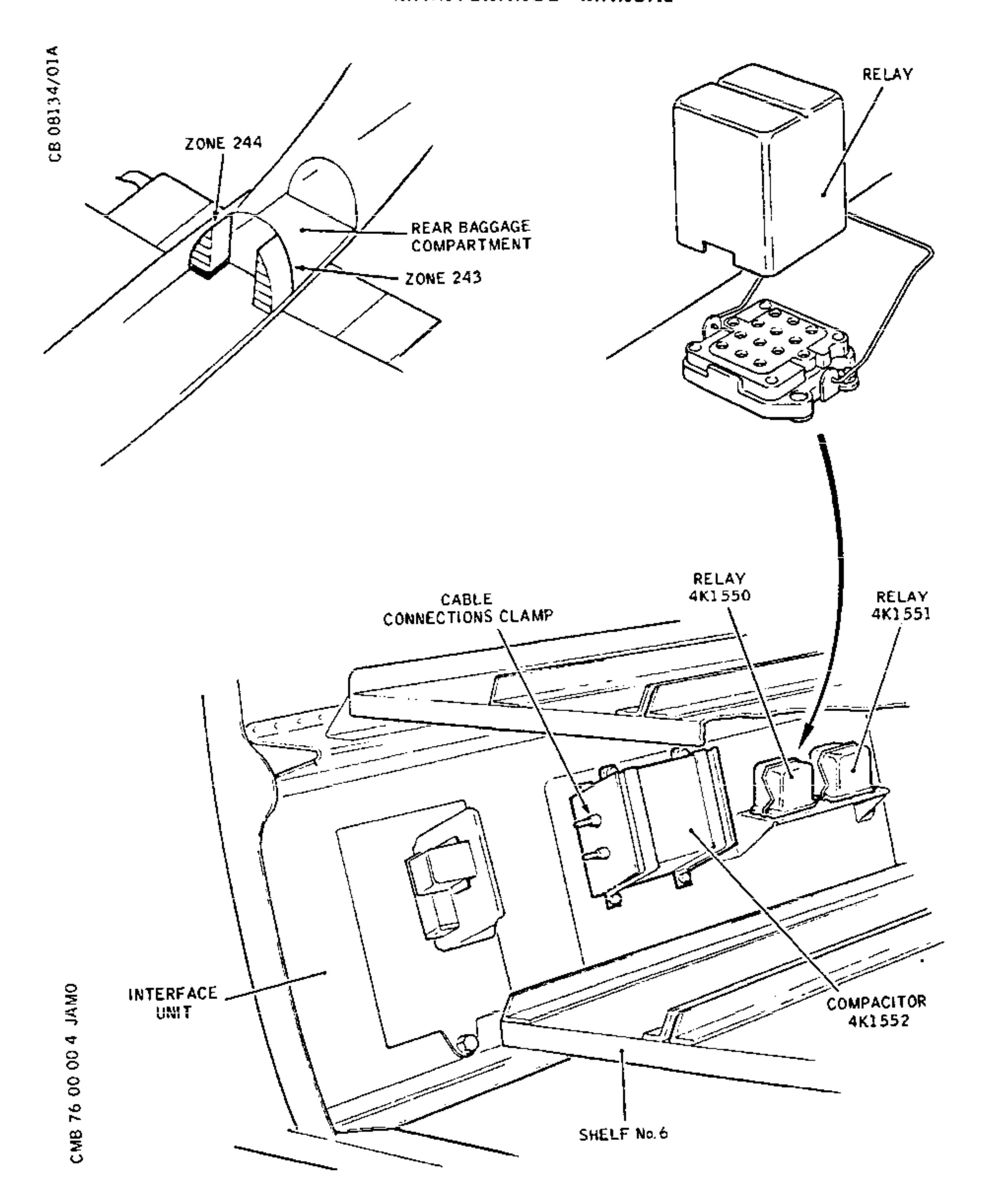
(2) Check that the relay pins are clean and undamaged.

(3) Align the locating pin on the relay body with the locating hole in the relay mounting base and plug the relay into the sockets.

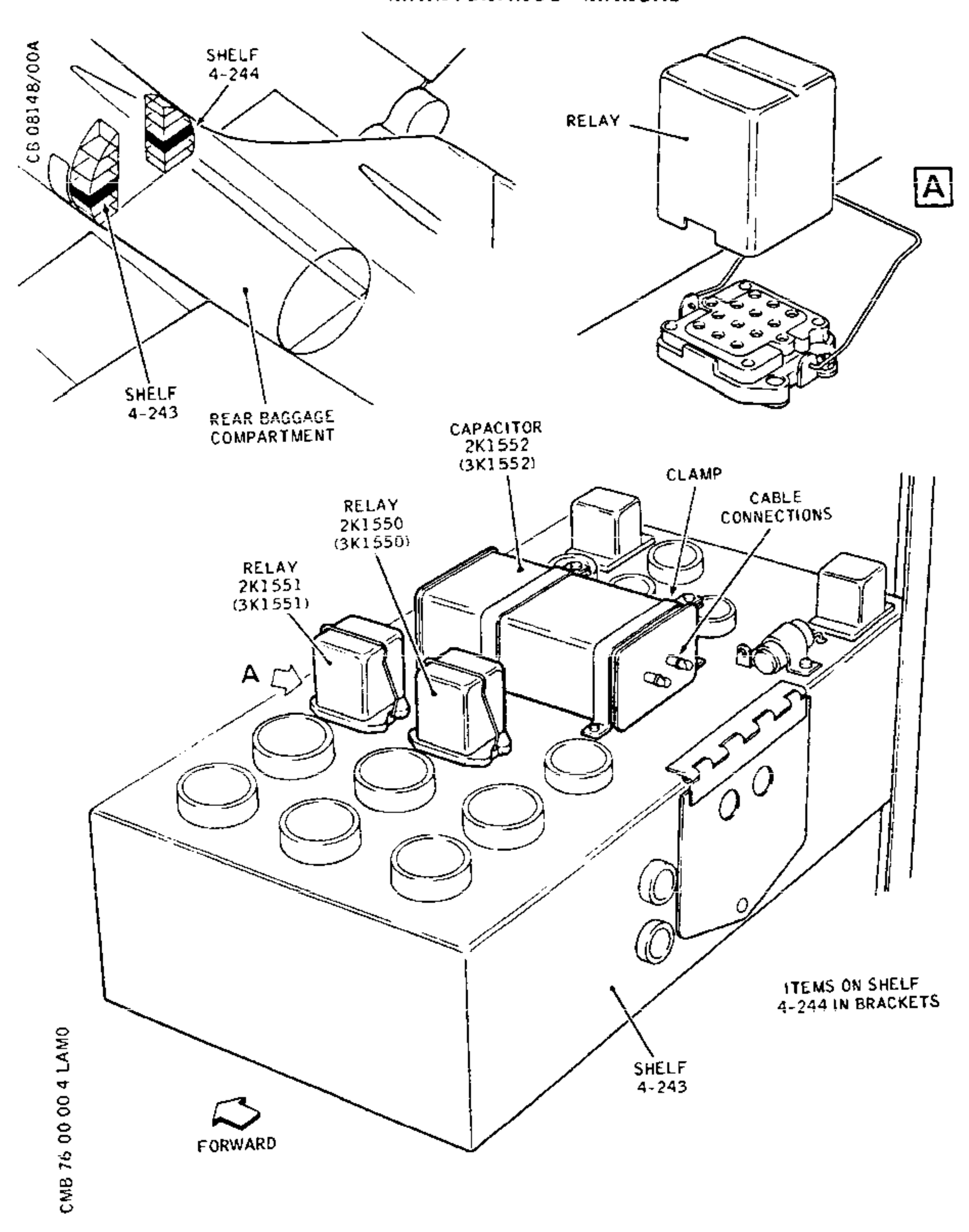
(4) Secure the relay body to the mounting base with the spring clamp, check that the clamp has engaged in the cover recess.



Minor Electrical Components Racking
3-243
Figure 410



Minor Electrical Components Racking
6-244
Figure 411



Minor Electrical Components Racking 4-243
Figure 412

E. Remove Capacitor

(1) Locate the shelf and the required capacitor.

(2) Unsolder the cables.

(3) Remove the screw and nut securing the clamp supporting the capacitor; remove the capacitor.

F. Install Capacitor.

(1) Comply with the electrical safety precautions.

(2) Engage the capacitor with the clamp and secure it with the screw and nut.

(3) Solder the cables to the capacitor in accordance with Wiring Diagram Manual (20-42-23).

(4) Secure the leads with suitable ties in accordance with 20-27-15.

G. Conclusion.

(1) Check that the area is clean.

(2) Check that any loom ties which have been disturbed are replaced in accordance with 20-27-15.

(3) Check that the panel cover seals are clean and undamaged and replace the cover.

(4) Remove the safety clips and reset the circuit breakers previously tripped.

(5) Carry out a test of the Power Control System (Ref. 76-15-00, Adjustment/Test).

9. Reheat Fuel Control - Deactivation Procedure

A. Equipment and Materials

DESCRIPTION	PART NO.
Voltmeter	-
Torq-set screwdriver	-

B. Ensure that "Automatic Contingency Rating Selection" signal for No. 1 Engine is Functioning.

(1) Check that the appropriate circuit breakers are set.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
RATING CONT	3-213	1K8	C 3
RATING IND SUP	3-213	K2300	G 5
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C12
ENG 2			
RATING CONT	1-213	2K8	E 8
RATING IND SUP	3-213	K2300	G 5
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	13-215	1K1541	B14
ENG 3			
RATING CONT	1-213	3K8	E 2
RATING IND SUP	3-213	K2300	G 5
REHEAT CONT	15-215	3K1542	D16
REHEAT AMP SUP	13-216	3K1541	B 7
ENG 4			
RATINC CONT	3-213	4K8	C 4
RATING IND SUP	3-213	K2300	G 5
REHEAT CONT	15-215	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7

(2) Make avaialble electrical ground power (Ref.24-41-00).

(3) Check RHT/CTY switches on panel 9-211, centre console, are at "OFF".

(4) Check ENG RATING MODE switches on panel 4-211, pilot's roof panel are at "TAKE-OFF".

(5) Check T/O indicator on pilot's left-hand dash panel 2-211 is illuminated.

(6) Push T/O MONITOR button, above the centre dash panel 6-211 to ARM, and latched.

(7) Set No. 1 RHT/CTY switch on centre console panel 9-211

to "RHT", check T/O indicator remains illuminated and CTY indicator flashes.

NOTE: If the CTY indicator does not illuminate, the automatic contingency rating selection signal is not functioning. The procedure must then be discontinued and reference made to 71-00-49, Trouble Shooting, to establish the fault.

(8) Set No.1 RHT/CTY switch to "OFF"; check CTY indicator is extinguished.

(9) Pull to INHIBIT T/O MONITOR pushbutton above the centre dash panel 6-211.

C. Ensure that "Reheat Off" Signal to No. 1 Engine Throttle Amplifier is functioning.

(1) Check that the appropriate circuit breakers are set.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
RATING IND SUP	3-213	K2300	G 5
MAIN THROT SUP	2-213	1K1	F12
ALTN THROT SUP	14-215	1K2	G12
MAIN THROT CONT	3-123	1K3	A 1
ALTN THROT CONT	15-216	1K4	E 8
MAIN THROT FAIL IND	1-213	1K5	A 1
ALTN THROT FAIL IND & AJ MAX SUP	3-213	1K6	B 1
E SCHD SUP 1	1-213	K34	E 7
E SCHD SUP 2	3-213	K35	B 3
ENG 2			
RATING IND SUP	3-213	K2300	G 5
MAIN THROT SUP	2-213	2K1	C12
ALTN THROT SUP	13-215	2K2	F14
MAIN THROT CONT	1-123	2K3	A 3
ALTN THROT CONT	15-215	2K4	F15
MAIN THROT FAIL IND	3-213	2K5	A 3
ALTN THROT FAIL IND & AJ MAX SUP	1-213	2K6	B 3
E SCHD SUP 1	1-213	K34	E 7
E SCHD SUP 2	3-213	K35	B 3
ENG 3			
RATING IND SUP	3-213	K2300	G 5

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
MAIN THROT SUP	2-213	3K1	C13
ALTN THROT SUP	13-216	3K2	C 5
MAIN THROT CONT	1-123	3K3	A 4
ALTN THROT CONT	15-215	3K4	F16
MAIN THROT FAIL IND	3-213	3K5	A 4
ALTN THROT FAIL IND & AJ MAX SUP	1-213	3K6	B 4
E SCHD SUP 1	1-213	K34	E 7
E SCHD SUP 2	3-213	K35	B 3
ENG 4			
RATING IND SUP	3-213	K2300	G 5
MAIN THROT SUP	2-213	4K1	F13
ALTN THROT SUP	14-216	4K2	C 7
MAIN THROT CONT	1-123	4K3	A 2
ALTN THROT CONT	15-216	4K4	F 9
MAIN THROT FAIL IND	1-213	4K5	A 2
ALTN THROT FAIL & AJ MAX SUP	3-213	4K6	B 2
E SCHD SUP 1	1-213	K34	E 7
E SCHD SUP 2	3-213	K35	B 3

(2) Set all THROTTLE MASTER switches, on roof panel 4-111 to "MAIN" or "ALTERN".

(3) Check all ENG RATING MODE switches are at "TAKE-OFF".

(4) Ensure all RHT/CTY switches, on centre console, at "OFF".

(5) Set ENGINE CONTROL SCHEDULE rotary selector on panel 1-214, at 3CM position, to "NORMAL".

(6) Set ENGINE CONTROL SCHEDULE switch to "HI".

(7) Check ENGINE CONTROL SCHEDULE indicators illuminate LO.

(8) Trip undercarriage weight switch circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
RH UC WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH UC WEIGHT SW 'B' SYS SUP	3-213	G293	B 8

(9) Check ENGINE CONTROL SCHEDULE indicators illuminate HI.

NOTE: If, for the affected engine, the HI indicator remains extinguished, and the LO is illuminated the 'reheat off' signal to the throttle control units is not functioning. The procedure must then be discontinued and reference made to 71-00-49, Trouble Shooting to establish the fault.

(10) Re-set UC weight switch circuit breakers previously tripped.

D. Inhibit No. 1 Reheat Fuel System.

CAUTION: THE AUTOMATIC CONTINGENCY RATING SELECTION AND THE 'REHEAT OFF' SIGNALS ARE TO BE FUNCTIONING REF PARAS A and B PRIOR TO THE DISCONNECTION OF THE REHEAT SYSTEM.

(1) Make available electrical ground power (Ref.24-41-00).

**ON A/C 001-006,

(2) Remove the cover from the rear vestibule rack, and locate the reheat control amplifier.

ENGINE NO	RACK	AMPLIFIER
No. 1	3-243	1K-1553 REHEAT
No. 2	4-243	2K-1553 REHEAT No.2

ENGINE NO	RACK	AMPLIFIER
No. 3	4-244	3K-1553 REHEAT No.3
No. 4	6-244	4K-1553 REHEAT No.4

**ON A/C 002-007,

(3) Remove the cover from the test plug on the amplifier and connect a voltmeter, to measure 28 Vdc between pin 'W' and earth.

(4) Advance the No. 1 throttle lever on the centre console to mid-travel.

(5) Set No.1 RHT/CTY switch to "RHT".

(6) Check at the amplifier, that the voltmeter reads approximately 28V dc.

(7) Set No. 1 RHT/CTY switch to "OFF".

(8) Isolate electrical generation and external power (Ref. 24-00-00, Servicing).

NOTE: Either Operations (9) or (10) may be performed whichever is most convenient.

(9) At rear compartment racking disconnect, tape and stow the appropriate cable for No.1 reheat system:

(a) Enter the rear baggage compartment for access to LH or RH racking:

(b) Remove the cover from LH racking 3-243.

(c) Locate tape and stow the appropriate cable in accordance with Wiring Diagram Manual 20-41-02.

REHEAT AMPLIFIER	CABLE IDENT	SHELF	TERMINAL BLOCK	STUD
1	1K209XK	7-234	UG2927	1
2	2K209XH	7-234	UG2927	2
3	3K209XH	7-244	UG2928	1
4	4K209XH	7-244	UG2928	2

(10) Open service compartment door 123BB (Ref. 52-41-11), locate the LH and RH engine relay boxes in the underfloor racking, and disconnect tape and stow the appropriate cable for No.1 reheat system:

NOTE: Relay boxes for reheat systems l and 2 are located on 19-213, and those for reheat systems 3 and 4 on 20-213.

(a) Release the hold-down fasteners from the appropriate engine relay box hold-down hooks.

(b) Withdraw the relay box from the racking sufficiently to gain access to the quick-release cable clamps on top of the box.

(c) Release the cable clamps to detach the cables from the top of the box.

(d) Move the relay box clear of the racking and lower it onto a suitable support.

(e) Remove the screws securing the back of the relay box.

(f) Disconnect cable from terminal A1 on the relay base, tape the loose end and stow in accordance with Wiring Diagram Manual 20-41-02.

REHEAT AMPLIFIER	PANEL	RELAY
1	19-123	1K-727
2	19-123	2K-727
3	20-123	3K-727

REHEAT AMPLIFIER	PANEL	RELAY
1	19-123	1K-727
4	20-123	4K-727

(g) Check that the area is clean, replace the back of the relay box and secure it with the four screws; torque-tighten the screws to between 12 to 15 lbf in (0.14 - 0.17 mdaN).

(h) Mount the relay box on the end of the rack support rails and secure the cables to the top of the engine relay box with the quick-release cable clamps.

(j) Slide the box into the racking and secure it with the hold-down fastener.

(k) Check the relay box is bonded in accordance with 24-27-11.

(l) Check that area is clean and lock the service compartment door 123 BB (Ref. 52-41-11).

(11) Cancel the electrical safety precautions.

E. After Inhibiting No.1 Reheat Fuel System

(1) Make available electrical ground power (Ref.24-41-00).

(2) Set the No.1 RHT/CTY switch, to RHT.

(3) At the reheat amplifier check that the voltage on pin 'W' remains at zero.

CAUTION: IF THERE IS STILL A 28V DC SIGNAL ON PIN 'W' THIS PROCEDURE SHOULD BE DISCONTINUED AND REFERENCE MADE TO 71-00-29, TROUBLE SHOOTING.

(4) Set all RHT/CTY switches to "OFF".

(5) Disconnect and remove electrical ground power (Ref. 24-41-00).

(6) Move the throttle lever to idle.

(7) Remove voltmeter; replace dust cover and panel cover at rear vestibule.

(8) Ensure that the 'reheat off' signal to No.1 engine throttle control unit is maintained by repeating para.9C.

10. Reheat Fuel Control - Reactivation Procedure

A. Equipment and Materials

DESCRIPTION	PART NO.
Voltmeter	-
Torq-set screwdriver	-

B. Preparation

(1) Isolate electrical generation and external power (Ref. 24-00-00, Servicing).

(2) Trip the appropriate circuit breakers and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1 REHEAT CONT	15-216	1K1542	E 9
ENG 2 REHEAT CONT	15-215	2K1542	D15
ENG 3 REHEAT CONT	15-215	3K1542	D16
ENG 4 REHEAT CONT	15-216	4K1542	E10

**ON A/C 001-006,

(3) Remove the cover from the rear vestibule rack and locate the reheat control amplifier.

ENGINE NO	RACK	ENGRAVING
No.1	3-243	1K1553 REHEAT
No.2	4-243	2K1553 REHEAT No.2
No.3	4-244	3K1553 REHEAT No.3
No.4	6-244	4K1553 REHEAT No.4

**ON A/C 002-007,

(4) Remove the cover from the test plug on the amplifier and connect a voltmeter between pin 'W' and earth.

C. Reconnect Reheat System.

NOTE: Either operations (1) to (3) or (4) to (15) are to be performed whichever is necessary to accord with the deactivation procedure in para 9C.

(1) Enter rear baggage compartment and remove the cover from LH racking 3-243.

(2) Locate the stowed cable for No.1 reheat system, remove the tape and connect the cable to the terminal block in accordance with the relevant wiring diagram and the cable identifcation.

REHEAT AMPLIFIER	CABLE IDENT	SHELF	TERMINAL BLOCK	STUD
1	1K209XK	7-234	UG2927	1
2	2K209XH	7-234	UG2927	2
3	3K209XH	7-244	UG2928	1
4	4K209XH	7-244	UG2928	2

(3) Check that the area is clean and that the panel cover seals are clean and undamaged. Replace the cover.

(4) Open service compartment door 123BB (Ref. 52-41-11) for access to LH and RH engine relay boxes.

(5) Release the hold-down fasteners from the appropriate engine relay box hold-down hooks.

(6) Withdraw the relay box from the racking sufficiently to gain access to the quick-release cable clamps on top of the box.

(7) Release the cable clamps to detach the cables from the top of the box.

(8) Move the relay box clear of the racking and lower it onto a suitable support.

(9) Remove the screws securing the back of the relay box.

(10) Locate the stowed cable, for No.1 reheat system, remove the tape and connect the cable to terminal A1 on the relay base in accordance with the cable identification and the relevant Wiring Diagram Manual.

REHEAT AMPLIFIER	PANEL	RELAY
1	19-123	1K-727
2	19-123	2K-727
3	20-123	3K-727
4	20-123	4K-727

(11) Check that the area is clean, replace the back of the relay box and secure it with the four screws; torque tighten the screws to between 12 to 15 lbf in (0.14 - 0.17 mdaN).

(12) Mount the relay box on the end of the rack support rails and secure the cables to the top of the engine relay box with the quick-release cable clamps.

(13) Slide the relay box into the racking and secure it with the hold-down fasteners.

(14) Check that the relay box is bonded in accordance with 20-27-11.

(15) Check that the area is clean and lock the service compartment door 123 BB (Ref. 52-41-11).

(16) Cancel the electrical safety precautions.

D. After Reconnecting Reheat System.

(1) Remove safety clips and reset the circuit breakers.

(2) Make available electrical ground power (Ref. 24-41-00).

(3) Set No. 1 RHT/CTY switch to "RAT".

(4) Check at pin 'V' on the reheat amplifier, that the voltmeter reads zero. Move the appropriate throttle lever to the 'mid' position; check at pin V on amplifier that voltmeter reads 28V.

CAUTION: IF THERE IS STILL A ZERO VOLTS ON PIN 'W' REFER TO 71-00-29, TROUBLE SHOOTING.

(5) Set RHT/CTY switch on to "OFF".

(6) Disconnect and remove electrical ground power (Ref. 24-41-00).

(7) Remove the voltmeter from the throttle amplifier; replace the dust cover.

(8) Check that the area is clean and replace the racking cover.

(9) Move the throttle lever back to the 'idle' position.

ENGINE CONTROLS - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

This topic details the checks required after installation of minor electrical components in an otherwise serviceable engine control system. Similar minor electrical component checks will be found in the relevant chapters.

The checks are to be made with the engine static, the instructions being given in most cases, for No 1 engine and may be repeated on the other engine systems.

2. Indicator - Engine Rating, Left-hand Dash Panel 2-211

A. Prepare

R (1) Ensure that circuit breaker RATING INDSUP, K2300,
R on panel 3-213, map ref G5 is reset.

(2) Make available electrical ground power (Ref. 24-41-00, Servicing).

B. Test

(1) Check the engine rating indicator lights filaments using the LIGHT TEST switch on panel 9-211 (Ref. 33-14-00).

(2) Retard throttle lever to idle; check T/O light is illuminated on the indicator.

(3) On the pilots' roof panel, set and hold ENG RATING MODE switch to FLIGHT, and confirm engine rating indicator agrees with ENG FLIGHT RATING selection:

(a) With ENG FLIGHT RATING switch at CLIMB, indicator CLB caption illuminates.

(b) With ENG FLIGHT RATING switch at CRUISE, indicator CRS caption illuminates.

(4) Release the spring loaded ENG RATING MODE switch; check T/O caption illuminates.

(5) On centre console, set RHT/CTY switch to RHT, then to CTY; check CTY caption light illuminates.

C. Conclusion

(1) Reset RHT/CTY switch to OFF.

(2) Remove electrical ground power (Ref. 24-41-00, Servicing).

3. Throt Caption - Centre Console Panel 9-211

A. Prepare

R (1) Reset the appropriate circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R Engine No.1			
R ENG 1 MAIN THROT FAIL IND	1-213	1K5	A1
R ENG 1 ALTN THROT FAIL IND & AJ MAX SUP	3-213	1K6	B1
R Engine No.2			
R ENG 2 MAIN THROT FAIL IND	3-213	2K5	A3
R ENG 2 ALTN THROT FAIL IND & AJ MAX SUP	1-213	2K6	B3
R Engine No.3			
R ENG 3 MAIN THROT FAIL IND	3-213	3K5	A4
R ENG 3 ALTN THROT FAIL IND & AJ MAX SUP	1-213	3K6	B4
R Engine No.4			
R ENG 4 MAIN THROT FAIL IND	1-213	4K5	A2
R ENG 4 ALTN THROT FAIL IND & AJ MAX SUP	3-213	4K6	B2

(2) Make available electrical ground power (Ref. 24-41-00, Servicing).

B. Test

(1) Check the caption filament using the LIGHTS TEST switch on the centre console panel 9-211 (Ref. 33-14-00).

(2) On the pilots' roof panel check the No 1 THROTTLE MASTER switch is OFF.

(3) Set No 1 HP VALVE switch to OPEN; check No 1 THROT

caption illuminates on the centre console.

C. Conclusion

(1) Reset No 1 HP VALVE switch to SHUT and remove ground power (Ref. 24-41-00, Servicing).

4. Engine Control Schedule Switch - Panel 1-214

WARNING: ENSURE THAT THE SECONDARY AIR DOORS ARE CLEAR OF PERSONNEL AND EQUIPMENT DURING THIS TEST.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare

R (1) Reset the appropriate circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
FLT CONT & NAV			
BUS 14XS	2-213	X355	H2
1st PLT ADC INST SUP	2-213	1F75	B3
NAV INST BUS 13XS	13-216	X345	G4
2 PLT ADC INST SUP	13-216	2F75	A14
E SCHD SUP 1	1-213	K34	E7
E SCHD SUP 2	3-213	K35	B3
NASU 1 SUP	14-216	K1136	A7
NASU 2 SUP	13-215	K1137	B13

(2) Make available electrical ground power (Ref. 24-41-00, Servicing).

C. Test

(1) On the pilots' roof panel, set all THROTTLE MASTER switches to MAIN.

(2) At the 3CM position set the FLYOVER/APPROACH rotary switch to NORMAL.

(3) Set the SECONDARY AIR DOOR switches to SHUT.

(4) Set the ENGINE CONTROL (E) SCHEDULE switch to AUTO; check all four captions on the annunciator (panel 1-214) illuminate LO.

R (5) Simulate an airspeed in excess of 220 knots, and check all E schedule annunciators illuminate HI in the following manner:

(a) Check that the ADS/ENGINE PROBE HEATERS switches on panel 4-211, pilots' roof panel are set to OFF.

R (b) Trip stick shaker circuit breaker STICK SHAKER
R SUP W513 on panel 1-213, map ref. P15.

R (c) Set ADC switches No 1 and No 2 on panel 9-211 centre console to ON.

R (d) Push-to-test amber light; check light goes out.

R (e) Set TEST 1 on No 1 and No 2 ADC rotary switches; check that the amber lights illuminate and, after
R some seconds, the blue lights illuminate and
R remain on.

R (f) Press and release amber ADC 1 and ADC 2 captions
R and check that the amber captions extinguish.

R (g) At the 3CM position; check all engine E schedule annunciators illuminate HI.

(6) Set ADC switches to NORMAL; check indicator illuminates LO.

(7) At the 3CM position, set E schedule switch to HI, trip undercarriage weight switch circuit breakers LH
R U/C WEIGHT SW B SYS SUP panel 3-213 G293 map ref B8
R and RH U/C WEIGHT SW A SYS SUP panel 1-213 G295 map
R ref M18; check annunciator illuminates HI.

(8) Set the E schedule switch to AUTO; check indicator illuminates LO.

(9) Reset SECONDARY AIR DOORS switch to AUTO.

R (10) Set ADC switches to OFF.

D. Conclusion

R (1) Remove electrical ground power (Ref.24-41-00, Servicing).

(2) Reset all circuit breakers to the ground electrical condition.

5. Engine Control (E) Schedule Annunciators (Indicators) Panel 1-214

WARNING: ENSURE THAT THE SECONDARY AIR DOORS ARE CLEAR OF PERSONNEL AND EQUIPMENT DURING THIS TEST.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare

R (1) Reset the appropriate circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
FLT CONT & NAV			
BUS 14XS	2-213	X355	H2
1st PLT ADC INST SUP	2-213	1F75	B3
NAV INST BUS 13XS	13-216	X345	G4
2 PLT ADC INST SUP	13-216	2F75	A14
NASU 1 SUP	14-216	K1136	A7
NASU 2 SUP	13-215	K1137	B13
E SCHED SUP 1	1-213	K34	E 7
E SCHED SUP 2	3-213	K35	B 3

(2) Trip the following circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
LH UC WEIGHT SW B SYS SUP	3-213	G293	B 8
RH UC WEIGHT SW A SYS SUP	1-213	G295	M18
ENG 1 HP VALVE CONT	3-213	1K131	C 1
ENG 2 HP VALVE CONT	1-213	2K131	C 3
ENG 3 HP VALVE CONT	1-213	3K131	C 4
ENG 4 HP VALVE CONT	3-213	4K131	C 2
No. 1 T1 PROBE HTR SUP	13-215	1H542	C 9
No. 2 T1 PROBE HTR SUP	14-215	2H542	E 8
No. 3 T1 PROBE HTR SUP	14-216	3H542	C14
No. 4 T1 PROBE HTR SUP	13-216	4H542	C11

(3) Make available electrical ground power (Ref 24-41-00, Servicing).

(4) Set all SECONDARY AIR DOOR switches to SHUT.

NOTE: This is a precautionary measure to prevent door operation.

C. Test

(1) Check the filaments using the lights test switch on panel 1-214 (Ref. 33-14-00, Adjustment/Test).

(2) Retard all throttle levers to idle.

(3) At 3CM position, panel 1-214, set FLYOVER/APPROACH rotary switch to FLYOVER.

R B (4) Make landing gear weight switch circuit breakers LH UC WEIGHT SW A SYS SUP panel 1-213 G292 Map ref. M17, and RH UC WEIGHT SW B SYS SUP panel 3-213 G294 map ref. B9 and trip G293 panel 3-213 map ref. B8, and G295 panel 1-213 map ref. M18.

R B (5) Simulate an airspeed in excess of 0.26M and check F/O illuminates on annunciator in the following manner:

(a) Check ADS/ENGINE PROBE HEATERS switches on pilots' roof panel 4-211, are set to OFF.

(b) Isolate stick shaker circuit breaker W513 map ref P15 in panel 1-213.

(c) Set ADC switches No 1 and No 2 on centre console

panel 9-211 to ON.

(d) Push-to-test amber light; check light goes out.

R B (e) Set TEST 1 on No.1 and No.2 ADC rotary switches; check that the amber lights illuminate and, after 3 seconds, the blue lights remain on.

R B (f) Check all four annunciators illuminate F/O.

R B (6) Set FLYOVER/APPROACH switch to NORMAL; check RI illuminates on warning indicator.

R B (7) Open HP cock circuit breakers (all four).

R B (8) Reset ADC switches to NORMAL.

R B (9) At the 3CM position, set APPROACH on rotary switch: Check that annunciator illuminates MID on all four positions.

R B (10) Reset landing gear weight switch circuit breakers; check annunciator illuminates LO.

R B (11) Reset all SECONDARY AIR DOOR switches to AUTO.

R B (12) Select ADC switches OFF.

D. Conclusion

(1) Remove ground electrical power (Ref. 24-41-00 Servicing).

(2) Reset all circuit breakers to the ground electrical condition.

6. Wind-down Caption - Panel 1-214

A. Prepare

(1) Make available electrical ground power (Ref 24-41-00, Servicing).

B. Test

R (1) At the 3CM position test the caption filaments and dimming facility using the Lights press-to-test switch on panel 1-214 (Ref. 33-14-00, Adjustment/Test).

(2) On the pilots' roof panel 4-211, set No 1 THROTTLE

MASTER switch to MAIN or ALTERN.

(3) At the 3CM lower right-hand position, panel 27-214, Set No 1 & 4 No 2 AIR SOV & WIND DOWN TEST rotary switch to position E, check the WIND DOWN caption, associated with No 1 power plant, illuminates.

(4) Set No 1 THROTTLE MASTER switch to OFF.

(5) Set No 1 & 4 No 2 AIR SOV & WIND DOWN TEST rotary switch to OFF.

C. Conclusion

(1) Remove electrical ground power (Ref. 24-41-00, Servicing).

7. FLYOVER/NORMAL/APPROACH Rotary Switch Panel 1-214

A. Test

(1) Carry out the test detailed in paragraph 5 for the engine control (E) schedule annunciators (indicators).

8. Throttle 10% Relays, Engine Relay Boxes 19-123 and 20-123

A. Equipment and Materials

DESCRIPTION	PART NO.
Test meter	-

B. Prepare

R (1) Reset the appropriate circuit breakers.

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	ENG 1 REHEAT CONT	15-216	1K1542	E9
R	ENG 2 REHEAT CONT	15-215	2K1542	D15
R	ENG 3 REHEAT CONT	15-215	3K1542	D16
R	ENG 4 REHEAT CONT	15-216	4K1542	E10

(2) Make available electrical ground power (Ref. 24-41-00, Servicing).

C. Test

(1) Set all throttle levers to idle.

(2) At the 3CM position, panel 1-214, press FLIGHT REV ARM push button; check button holds in.

(3) Move No 1 (or appropriate) throttle lever to 10% check FLIGHT REV ARM button resets.

(4) Remove cover from panel 3-243, and locate pin S on REHEAT amplifier test socket.

ENGINE No	RACK	AMPLIFIER
No 1	3-243	1K1553 REHEAT No 1
No 2	4-243	2K1553 REHEAT No 2
No 3	4-244	3K1553 REHEAT No 3
No 4	6-244	4K1553 REHEAT No 4

(5) On centre console, set No 1 (or appropriate) RHT/CTY switch to RHT; check at pin S on the amplifier for 28V d.c.

D. Conclusion

(1) Set RHT/CTY switch to OFF.

(2) Replace and secure the amplifier and panel covers.

(3) Retard throttle levers to idle.

(4) Remove electrical ground power (Ref. 24-41-00, Servicing).

9. <u>Relays 95%, Engine Relay Box 19-123, 20-123</u>

A. Equipment and Materials

DESCRIPTION	PART NO.
Test meter	-

B. Prepare

R (1) Reset the appropriate circuit breakers

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	Engine No.1			
R	ENG 1 REHEAT CONT	15-216	1K1542	E9
R	ENG 1 RATING CONT	3-213	1K8	C3
R	Engine No.2			
R	ENG 2 REHEAT CONT	15-215	2K1542	D15
R	ENG 2 RATING CONT	1-213	2K8	E8
R	Engine No.3			
R	ENG 3 REHEAT CONT	15-215	3K1542	D16
R	ENG 3 RATING CONT	1-213	3K8	E2
R	Engine No.4			
R	ENG 4 REHEAT CONT	15-216	4K1542	E10
R	ENG 4 RATING CONT	3-213	4K8	C4

(2) Make available electrical ground power (Ref. 24-41-00, Servicing).

C. Test

(1) Advance No 1 throttle lever (or appropriate) to max rpm stop and set remaining throttles at idle.

(2) Locate either one of the NASU units in the racking 10-215 or 1-216, remove the cover and check for 28V d.c. at pin X on test connector.

(3) At the 3CM position panel 1-214, set FLYOVER/APPROACH switch to FLYOVER.

(4) At the centre console, set No 1 RHT/CTY switch to RHT; check at pin X on NASU that voltage is zero.

(5) Set No 1 RHT/CTY switch to OFF; check at pin X on NASU that voltage remains at zero.

(6) Retard throttle lever to idle.

D. Conclusion.

(1) Replace NASU test connector cover and secure racking cover.

(2) Set FLYOVER/APPROACH switch to NORMAL.

(3) Remove electrical ground power (Ref. 24-41-00, Servicing).

(4) Return circuit breakers to the ground electrical condition.

10. Relay Reheat Selected, Box 19-123, 20-123

A. Equipment and Materials

DESCRIPTION	PART NO.
Test meter	-

B. Prepare

R (1) Reset the appropriate circuit breakers.

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	Engine No.1			
R	ENG 1 REHEAT CONT	15-216	1K1542	E9
R	ENG 1 RATING CONT	3-213	1K8	C3
R	Engine No.2			
R	ENG 2 REHEAT OCNT	15-215	2K1542	D15
R	ENG 2 RATING CONT	1-213	2K8	E8
R	Engine No.3			
R	ENG 3 REHEAT CONT	15-215	3K1542	D16
R	ENG 3 RATING CONT	1-213	3K8	E2

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SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R Engine No.4			
R ENG 4 REHEAT CONT	15-216	4K1542	E10
R ENG 4 RATING CONT	3-213	4K8	C4

(2) Make available electrical ground power (Ref. 24-41-00, Servicing).

C. Test

(1) Advance No 1 throttle lever (or appropriate) to max rpm stop and set remaining throttles to idle.

(2) Locate either one of the NASU units in the racking 10-215 or 1-216, remove the cover and check for 28V at pin X of test connector.

(3) Set throttle lever to idle and check at pin X that voltage is zero.

(4) On the centre console set No 1 RHT/CTY switch to RHT, check for 28V at pin X of test connector.

(5) At the centre dash panel, check that the reheat select lamp in the % AREA gauge bezel is illuminated.

(6) At the centre console, set No 1 RHT/CTY switch to OFF.

(a) Check % AREA gauge light goes out.

(b) Check at pin X on NASU that voltage is zero.

D. Conclusion

(1) Secure the cover on the racking 10-215 or 1-216.

(2) Retard throttle lever to idle.

(3) Remove electrical ground power (Ref. 24-41-00, Servicing).

(4) Return circuit breakers to the ground electrical condition.

11. Relay AUTO/CONT, Engine Relay Box 11-123

A. Equipment and Materials

DESCRIPTION	PART NO.
Test meter	-

B. Prepare

R (1) Reset the appropriate circuit breakers.

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	Engine No.1			
R	ENG 1 RATING CONT	3-213	1K8	C3
R	ENG 1 REHEAT CONT	15-216	1K1542	E9
	RATING IND SUP	3-213	K2300	G5
	1 & 4 EMER RE'LT BUS SELECT SUP	3-213	4X230	H8
R	Engine No.2			
R	ENG 2 RATING CONT	1-213	2K8	E8
R	ENG 2 REHEAT CONT	15-215	2K1542	D15
	RATING IND SUP	3-213	K2300	G5
	2 & 3 EMER RE'LT BUS SELECT SUP	1-213	1X230	R10
R	Engine No.3			
R	ENG 3 RATING CONT	1-213	3K8	E2
R	ENG 3 REHEAT CONT	15-215	3K1542	D16
	RATING IND SUP	3-213	K2300	G5
	2 & 3 EMER RE'LT BUS SELECT SUP	1-213	1X230	R10
R	Engine No.4			
R	ENG 4 RATING CONT	3-213	4K8	C4
R	ENG 4 REHEAT CONT	15-216	4K1542	E10
	RATING IND SUP	3-213	K2300	G5
	1 & 4 EMER RE'LT BUS SELECT SUP	3-213	4X230	H8

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(2) Make available electrical ground power (Ref. 24-41-00, Servicing).

C. Test

(1) At the centre console, set all four RHT/CTY switches to RHT.

(2) Above the centre dash panel 6-211, press the T/O MONITOR button; check CTY caption (yellow) flashes in the engine rating indicator on left-hand dash panel 2-211.

(3) At the reheat amplifier test socket (Ref. para.8) check at pin Z for 28 Volts (Buffered by 10K ohms).

D. Conclusion

(1) Set RHT/CTY switches to OFF.

(2) Replace and secure amplifier and panel covers.

(3) Pull to inhibit the T/O MONITOR push-button above the centre dash panel.

(4) Remove electrical ground power (Ref. 24-41-00, Servicing).

(5) Return circuit breakers to the ground condition.

12. Speed Slave Relay, Engine Relay Box 11-123

A. Prepare

(1) Set the appropriate circuit breakers.

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	Engine No.1			
R	ENG 1 RATING CONT	3-213	1K8	C3
R	ENGINE 1 REHEAT CONT	15-216	1K1542	E9
	RATING IND SUP	3-213	K2300	G5
	1 & 4 EMER RE'LT BUS SELECT SUP	3-213	4X230	H8
R	Engine No.2			
R	ENG 2 RATING CONT	1-213	2K8	E8
R	ENG 2 REHEAT CONT	15-215	2K1542	D15

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
	RATING IND SUP	3-213	K2300	G5
	2 & 3 EMER RE'LT			
	BUS SELECT SUP	1-213	1X230	R10
R	Engine No.3			
R	ENG 3 RATING CONT	1-213	3K8	E2
R	ENG 3 REHEAT CONT	15-215	3K1542	D16
	RATING IND SUP	3-213	K2300	G5
	2 & 3 EMER RE'LT			
	BUS SELECT SUP	1-213	1X230	R10
R	Engine No.4			
R	ENG 3 RATING CONT	3-213	4K8	C4
R	ENG 4 REHEAT CONT	15-216	4K1542	E10
	RATING IND SUP	3-213	K2300	G5
	1 & 4 EMER RE'LT			
	BUS SELECT SUP	3-213	4X230	H8

(2) Make available electrical ground power (Ref. 24-41-00, Servicing).

B. Test

(1) At the centre console, set all four RHT/CTY switches to RHT.

(2) Above the centre dash panel 6-211, press the T/O MONITOR button; check CTY caption (yellow) flashes on the engine rating indicator, on panel 2-211.

(3) Pull to inhibit T/O MONITOR button.

(4) Set RHT/CTY switches to OFF.

C. Conclusion

(1) Remove electrical ground power (Ref. 24-41-00, Servicing).

(2) Return circuit breakers to the ground condition.

13. Flasher Unit, Relay Box 11-123

(1) Carry out the check described for the AUTO/CONT

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relay in paragraph 11.

14. THROTTLE MASTER switch, Panel 4-211

A. Prepare

R (1) Reset appropriate circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1 ALTN THROT CONT	15-216	1K4	E8
ENG 2 ALTN THROT CONT	15-215	2K4	F15
ENG 3 ALTN THROT CONT	15-215	3K4	F16
ENG 4 ALTN THROT CONT	15-216	4K4	F11
ENG 1 MAIN THROT CONT	3-213	1K3	A 1
ENG 2 MAIN THROT CONT	1-213	2K3	A 3
ENG 3 MAIN THROT CONT	1-213	3K3	A 4
ENG 4 MAIN THROT CONT	3-213	4K3	A 2
ENG 1 MAIN THROT FAIL IND	1-213	1K5	A 1
ENG 2 MAIN THROT FAIL IND	3-213	2K5	A 3
ENG 3 MAIN THROT FAIL IND	3-213	3K5	A 4
ENG 4 MAIN THROT FAIL IND	1-213	4K5	A 2
ENG 1 ALT THROT FAIL IND & AJ MAX SUP	3-213	1K6	B 1
ENG 2 ALT THROT FAIL IND & AJ MAX SUP	1-213	2K6	B 3
ENG 3 ALT THROT FAIL IND & AJ MAX SUP	1-213	3K6	B 4
ENG 4 ALT THROT FAIL IND & AJ MAX SUP	3-213	4K6	B 2

(2) Make available electrical ground power (Ref. 24-41-00, Servicing).

B. Test

(1) On pilots' roof panel, 4-211 set No 1 THROTTLE MASTER switch to OFF.

(2) Set No 1 HP VALVE switch to OPEN; check No 1 THROT caption illuminates on the centre console and MWS operates.

(3) On the roof panel, set No 1 THROTTLE MASTER switch to MAIN; check THROT caption goes out.

(4) Set No 1 THROTTLE MASTER switch to OFF; check caption illuminates.

(5) Set No 1 THROTTLE MASTER switch to ALTERN; check caption goes out.

C. Conclusion

(1) Set THROTTLE MASTER switch OFF and HP VALVE switch to SHUT.

(2) Remove electrical ground power (Ref. 24-41-00, Servicing).

(3) Return circuit breakers to the ground electrical condition.

POWER CONTROL - DESCRIPTION AND OPERATION

1. General

Engine power is controlled by regulation of the fuel flow to the engine and reheat combustion systems together with adjustment of the primary nozzle area. The control systems act on pilot's demand, monitor essential engine parameters and impose an automatic control to both meet the demand and ensure that the engine parameters do not deviate beyond their preset limits at any stage of the full range of operation. Safety circuits are incorporated in the electrical control system which sense certain control faults and react automatically to maintain a safe engine condition and to operate a warning system.

The engine and reheat control systems consist primarily of electrical components which form electrical links between manually operated controls in the flight compartment and electro-mechanical operating components at the engine. Each engine has a separate control channel with two electrical control lanes with each lane under the command of a control amplifier (Ref. Fig. 001). The final stage components of the engine control system are the actuator gearbox (TV), which drives the fuel flow control unit (FCU) throttle valve and the primary nozzle trim unit, which imposes control on the operating pneumatic system of the primary nozzle. For each engine, a reheat selector switch and single control amplifier activate the reheat fuel controller, the final stage component in the reheat control system. The reheat fuel controller incorporates a shut-off valve, a metering valve and a purge valve.

Selector switches for either main or alternate lane engine control system and for reheat or contingency selection connect to the amplifier units together with other switches that provide for selection of specific engine operating conditions. A fuel HP shut-off valve switch connects to the start valve and shut-off valve solenoids of the FCU and forms a direct on/off control of fuel flow to the engine as described in 73-20-00. The flight compartment control switches are operated manually to select a control lane and to open the HP fuel shut-off valve. Starting and running procedures are given in Chapter 71-00-00.

Each of the pilot's throttle levers connects mechanically to a transmitter in the centre console and serves one engine control channel (Ref. Fig. 002). The transmitter for each channel has two equal electrical outputs, one for each of the two control amplifiers, with each of the

CR 31951/008

HP FUEL (SHUT-OFF) SWITCH

START AND SHUT-DOWN VALVES

POWER SUPPLIES

SENSING SIGNALS

F.C.U.

ENGINE DEBOW SWITCH

ENGINE GROUND IDLE SWITCH

ENGINE CONTROL AMPLIFIER (MAIN)

THROTTLE VALVE ACTUATOR GEARBOX

THROTTLE VALVE

P.N.C. TRIM UNIT

ENGINE CONTROL SCHEDULE SWITCHES

ENGINE RATING MODE SWITCH

ENGINE FLIGHT RATING SWITCH

THROTTLE MASTER SWITCH

POWER SUPPLIES

SENSING SIGNALS

AUTO IGNITION SWITCH

ENGINE CONTROL AMPLIFIER (ALTERNATE)

CMR 76 10 00 0 AAF0

PILOTS THROTTLE LEVER TRANSMITTER

MAIN LANE

ALTERNATE LANE

REHEAT AND CONTINGENCY SELECTOR SWITCH

REHEAT CONTROL AMPLIFIER

REHEAT FUEL CONTROLLER

Engine Control Channel Simplified Schematic
Figure 001

R

R outputs carrying two signals. The control amplifiers are identical and each is effective in its own lane of control. The lane to be effective in control, main or alternate, is determined by the control switch setting. The throttle actuator gearbox and the nozzle trim unit both have two a.c. motors, one for each lane of control, which receive the control amplifier outputs and convert them to mechanical control movement.

R Sensing units on each engine transmit monitored signals to their respective amplifiers for each engine control channel. RPM probes transmit signals proportional to engine rotor speeds, N1 for the LP rotor assembly and N2 for the HP rotor assembly. A temperature probe provides a signal T1 in respect of total air temperature at the engine intake face and a thermocouple generates a signal proportional to the exhaust gas temperature EGT. Other sensing signals to the control amplifiers impose control modifying inputs to meet specific aircraft and engine operating conditions.

R The control system is designed so that, over the majority of the range, the pilot's lever angle bears a substantially linear relationship to engine power. The full power position of the lever corresponds to maximum HP rotor speed for a selected rating, subject to no other limit being exceeded. The control system acts as an engine speed governor over the majority of the power range, with the advantage that a demanded speed will be maintained over a wide range of flight conditions.

R In each control lane, the pilot's throttle lever movement is translated into electrical signals by the rotary transformers which are the power demand control inputs to the engine control amplifiers. Movement of the lever will give a change of input signal values and result in an output to the actuator gearbox which then resets the throttle valve to provide the new power demand fuel flow as described in 73-20-00. Sensing signal inputs to the amplifier unit in respect of throttle valve position or N2 will automatically control amplifier output to stop the actuator gearbox when the power demand is met. Limiting signals, relative to acceleration and operating temperatures, will restrain the engine within the limits of the operating parameters.

R Sensing signals, relative to engine rotor assembly speeds initiate an output to the nozzle trim unit. This adjusts the primary nozzle area and controls the LP rotor to HP rotor speed relationship and maintains optimum engine performance for any operating condition throughout the

CR 31942/00B

PILOTS LEVER
THROTTLE MASTER
ALTERN
O
F
F
MAIN
A
R THROT R
ENGINE CONTROL SCHEDULE
NORMAL
FLYOVER F/O
APPROACH (MID)
F/O
HI
MID
LO
HI
AUTO
LO
NASU
ENGINE RATING MODE
TAKE OFF
FLIGHT
ENGINE FLIGHT RATING
CLIMB
CRUISE
TO REHEAT CONTROL AMPLIFIER
AUTO IGNITION
ON
OFF
ENGINE CONTROL MAIN AMPLIFIER
ENGINE DEBOW
NORMAL
DEBOW
ENGINE STARTING
RELIGHT
OFF
START
E.G.T. FAILURE
GRD
IDLE
HI
LO
ENG 1-4
WIND DOWN LOGIC NETWORK
WIND DOWN
BUCKET SWITCH
NOZ AIR SOV AND WIND DOWN TEST
ENG 1 & 4
ENG 2 & 3
OFF A B C D E
ENG O/HEAT TEST FIRE & NAC O/HEAT TEST
2 CTY 3
4
RHT
OFF
OFF
OFF
REHEAT SELECTOR

CMR 76 10 00 0 AAMA

Engine Control Lane and Reheat Control Schematic (Sheet 1 of 2)
Figure 002

R

CR 32555/00 B

MECHANICAL DRIVE
MAIN
ALTERNATE
CONTROL SIGNAL
MAIN
ALTERNATE
MONITORED SENSING SIGNAL
MAIN
ALTERNATE
INDICATION SIGNAL

FUEL
ACTUATOR GEARBOX
M
M
A A
TO SPRAYERS
P_∞
T_∞
AUTO $N_1/\sqrt{\theta}$ REDUCE
T_1 TEMPERATURE PROBE
ADJACENT ENGINE
EGT THERMOCOUPLE
N_2 PROBE
N_1 PROBE
P3 ACTUATING AIR
THRUST REVERSE SELECTED BUCKET POSITION
AIR TO JACKS
TO START AND IGNITION CIRCUITS (74-00-00 AND 80-00-00)
ENGINE CONTROL MAIN AMPLIFIER
PNC TRIM UNIT
PM AIR
PNC PNEUMATIC VALVE
P_3 SENSING AIR
P_1
ENGINE FUEL FE FLOWMETER
R H DETECTION
TO REHEAT IGNITION (74-00-00)
TO INJECTION SYSTEM
T_1 A
T_1
N_1
ENGINE RATING MODE
REHEAT CONTROL AMPLIFIER
PURGE AIR SOLENOID VALVE
REHEAT CONTROLLER
PURGE VALVE
FUEL
CMR 76 10 00 0 AAMB
REHEAT FAIL WARNING
CONFIGURATION
REHEAT FUEL (FR) FLOWMETER
REHEAT SELECTED

Engine Control Lane and Reheat Control Schematic (Sheet 2 of 2)
Figure 002

R

R flight envelope. Circuitry defining the desired running
R line is combined with an intake temperature computer
R within the amplifier to obtain a nett control line.
R Control action is effected by varying the area of the
R primary nozzle via an HP compressor delivery pressure/
R jet pipe pressure (P3/PJ) pneumatic control loop.

The reheat control system of each engine forms an electrical link between the pilot's reheat control switch and the fuel metering valve drive, similar to that of the engine control system, but power demand is wholly under the command of the reheat control amplifier. The reheat selector circuit is routed through the throttle lever switches and switching
R contacts at the engine shut-down handle. Control of
R reheat is automatic the prime control signal establishing
R a reheat fuel flow Fr relative to engine fuel flow Fe
R depending on intake air temperature T1.

Safety circuits are incorporated in each of the control amplifiers. If the amplifier in the effective engine control lane detects an internal fault or a fault in associated electrical components, an automatic change-over to the other control lane occurs and warning indication is given. A fault detected by an operative reheat control amplifier initiates an automatic reheat shut-down and/or warning indication.

The secondary nozzles can be selected to provide a reverse thrust as described in 78-30-00. A wind-down system is initiated and engine power is reduced if the buckets move from
R the position demanded by the pilots throttle lever or
R reverse levers.

In the flight compartment, visual indication of control system selection and functioning is given. The master warning system (MWS) supplements flight compartment warnings of an engine
R control system fault by an audible and visual display on
the roof panel.

2. Actuator Gearbox (TV)

The throttle valve actuator gearbox, shown in the illustration
R (Ref. Fig. 003), and described in detailed in 76-11-01,
R is bolted to the bottom face of the FCU. The actuator
R gearbox drive quillshaft is in splined engagement with
R the throttle valve drive of the FCU as determined by a
R master spline. A gear train with a differential action
R transmits the drive from two electrical motors to the
R quillshaft. Assembly pins locate the mating faces of the
R two units between which a seal plate is located. There
R are two electrical receptacles for the harness lead
R connections, one for each of the two driving motors and a

drains outlet connection is provided for the engine seal failure drains system.

In response to the pilot's throttle lever setting the engine electrical control system will transmit signals to the actuator gearbox motor effective in control. The motor will respond to a signal and drive the gear train and throttle valve to the desired position. The effective synchro transmitter and motor will send position and velocity feedback signals to the engine control amplifier in command. These signals will modify the control signal and control the rate of movement so that the throttle valve movement can be stopped immediately the setting demanded is reached.

3. Control Amplifier Engine Electrical Control System (Main and Alternate)

Two engine control amplifiers are provided for each engine and are located in racks 215 and 216 as shown in the illustration (Ref. Fig. 004) and the following list:

Engine	1	2	3	4
Main Amplifier	8-215	6-215	8-216	6-216
Alternative Amplifier	6-215	8-215	6-216	8-216

Each amplifier weighs 22.5 lb (10.2 kg) and is held in place by a pair of latches built into the carrying handles on the front panel. Electrical connections to the amplifier are made via three, 57-way plugs at the rear of the case. These mate with corresponding sockets in the rack when the amplifier is secured in place.

A detailed description of the control amplifier and its circuits is given in 76-11-11. The front panel of the amplifier carries two test sockets, normally shielded by protective caps. The lower of these caps, socket SKT1, contains wire-in links and must not be removed except for testing purposes. Both test sockets are used in conjunction
R with the ground test set. A hinged, wire-locked panel
R allows access to a group of preset potentiometers and it
R also, when closed, retains the two position EGT switch of the
R type A6A16/24DC control amplifiers in its selected position.
R Below this panel is an elapsed time meter, recording the
R length of time for which the amplifier has been energised.
R The front panels of type A6A16/24CC and /24DC control
R amplifiers also incorporate four light emitting diode
R indicators and the reset push button for a fault identification
R module (FIM). When the FIM facility is made effective, it
R enables some defects to be directly identified.

CR 31883/00B

ACTUATOR GEARBOX (TV)
FCU
A
B
PLUG
B
SEALS DRAIN CONNECTION

RECEPTACLES
ACTUATORS
SEAL PLATE ASSEMBLY
GEAR TRAIN
SYNCHRO TRANSMITTERS
QUILLSHAFT
A

CMR 76 10 00 0 BAFO

Actuator Gearbox (TV)
Figure 003

R

CR 32599/00C

A

LEFT HAND FLIGHT DECK RACKING (FRAME 7)

A

NO. 1 ENGINE (ALTERNATE)

NO. 2 ENGINE (MAIN)

6-215

NO. 1 ENGINE (MAIN)

8-215

NO. 2 ENGINE (ALTERNATE)

CMR 76 10 00 0 BAM0

Engine Control Amplifier and Installation Location
Figure 004

R

The control amplifier operates from the 28V d.c. and the 115 V, 400 Hz, single phase a.c. aircraft electrical supplies and produces an electrical signal to drive the engine fuel flow control unit (FCU) throttle valve to the setting that gives the engine power demanded by the pilot. The main input to the amplifier is an electrical signal generated by the pilot's throttle lever transmitter relative to the lever position. Engine parameters such as temperatures and rotor assembly speeds, are monitored by transducers whose outputs are fed to the control amplifier. The amplifier processes these signals according to a pre-determined set of laws and modifies the throttle demand from the pilot's lever so as to ensure that the engine is operated within its design limits. The amplifier also produces an electrical signal to set the primary nozzle control trim unit and activate the pneumatic servo system used to position the primary nozzle petals that control the LP and HP rotor speed relationship.

The control amplifier computation is a continuous process and the pilot's throttle lever is, in effect, a power lever. The optimum relationship between N1 and N2 for any condition within the flight envelope is computed within the amplifier in accordance with a set of operating curves known as the engine control schedule (E schedule).

4. Pilot's Throttle Control Transmitter

Four throttle control transmitters, shown in the illustration (Ref. Fig. 005) are mounted in racking in the lower part of the centre console in the flight compartment. Each transmitter is secured in position by an integral hold-down device which locates in slots at the ends of the two associated support plates. An assembly pin on a transmitter side face engages a slot in one support plate and ensures correct installation. The knurled thumbscrew of the hold-down device will jack the transmitter in or out of the location and engage or disengage both the mechanical coupling and electrical connections respectively.

Electrical connections are made via two, nine-way connectors on the mounting face of the transmitter that mate with corresponding connections on the racking assembly.

Each throttle lever is coupled to one transmitter by means of rods and levers and a gearing in the centre console.

The transmitter consists of a frame housing and a pair of gear driven, rotary transformers. A slotted coupling is driven by the output shaft of the gearing when the associated pilot's lever is operated. Each of the rotary transformers

is driven from the coupling via an intermediate shaft. This shaft carries a cam which operates against a stop pin to limit rotation of the coupling to 60 deg. The driven gears of the intermediate shaft and the two transformers are of the spring-loaded, anti-backlash type.

In each transmitter, each rotary transformer is energized from independent reference supplies derived from the separate, main and alternate, control amplifiers and each transformer feeds governor and positioner signals back to its associated amplifier. One transformer provides the throttle signals for the main control lane. The second transformer provides identical signals for the alternate control lane.

The reference supply to each transformer is 50 V, 400 Hz, single phase. The output signals vary, with respect to the reference supply, depending on the angular position of the transformer rotor. This variation is used by the control amplifier as a measure of the pilot's lever position.

5. T1 Temperature Probe - Description and Operation

The T1 temperature probe, shown in the illustration (Ref. Fig. 006), is used to sense the total air temperature and is located in each air intake diffuser to the rear of the rear ramp hinge. The design of the probe is such that the sensing element is protected against foreign object damage.

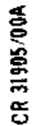
The probe is a dual element, de-iced, platinum resistance total temperature probe with a 115 V a.c. self-regulating de-icing heater. The heating element is energized when the HP VALVE switch of the engine concerned is set to OPEN. A warning light illuminates when heater fails to operate. The reference power consumption of the heater is 270 watts, approximately 260 watts under in-flight conditions.

The unique design permits operation in icing conditions with little error due to de-icing heat and also enables the probe to measure correctly the free air total temperature in wet conditions.

The rate of air flow over the hermetically sealed platinum resistance elements is controlled by a machined choke in the element tube.
When air flows over the elements, the resistance of each element varies with the air temperature.

6. Forward and Reverse Thrust Lever Baulks

The forward and reverse solenoid baulks are located in the pilot's centre console. The baulks are solenoid operated



THROTTLE LEVER ROD
RACKING ASSEMBLY
TRANSMITTER PACK
THUMB NUT
SECURING DEVICE
LEVER

POSITIONER OUTPUT
REFERENCE INPUT
GOVERNOR OUTPUT
TO MAIN ENGINE CONTROL AMPLIFIER

MOTION FROM PILOTS THROTTLE LEVER

POSITIONER OUTPUT
REFERENCE INPUT
GOVERNOR OUTPUT
TO ALTERNATE ENGINE CONTROL AMPLIFIER

CMR 76 10 00 0 BAU0

Pilot's Throttle Control Transmitter
Figure 005

CR 32553/008

AIR INTAKE DIFFUSER
PROBE BASE
PROBE
A

AIR INTAKE DIFFUSER
SENSING ELEMENTS
AIR FLOW
AIR EXIT TO SIDE PORT
A

C
J
K
H
D
E
F
G
A
B
TEMPERATURE DETECTORS
DE-ICING HEATER ELEMENT
WIRING DIAGRAM

CMR 76 10 00 0 CAF0

T1 Temperature Probe and Location Detail
Figure 006

R

in response to switch action by the bucket position indicator transmitter. When the solenoids are energized, the baulks are removed permitting movement of the forward or reverse thrust lever.

7. Engine RPM Probes (Ref. Fig. 007)

Two engine rpm probes are used in each engine control system. The LP compressor probe is located in the pulse probe drive and housing and the HP compressor probe is located in the base of the LH gearbox. The probes are described in detail in 76-12-00.

Each probe has a permanent magnet with sensing coils. A toothed wheel rotating in close proximity to the probe pole pieces induces an e.m.f. in each of the sensing coils. The frequency of the induced e.m.f. is proportional to the shaft speed and forms the output signal required.

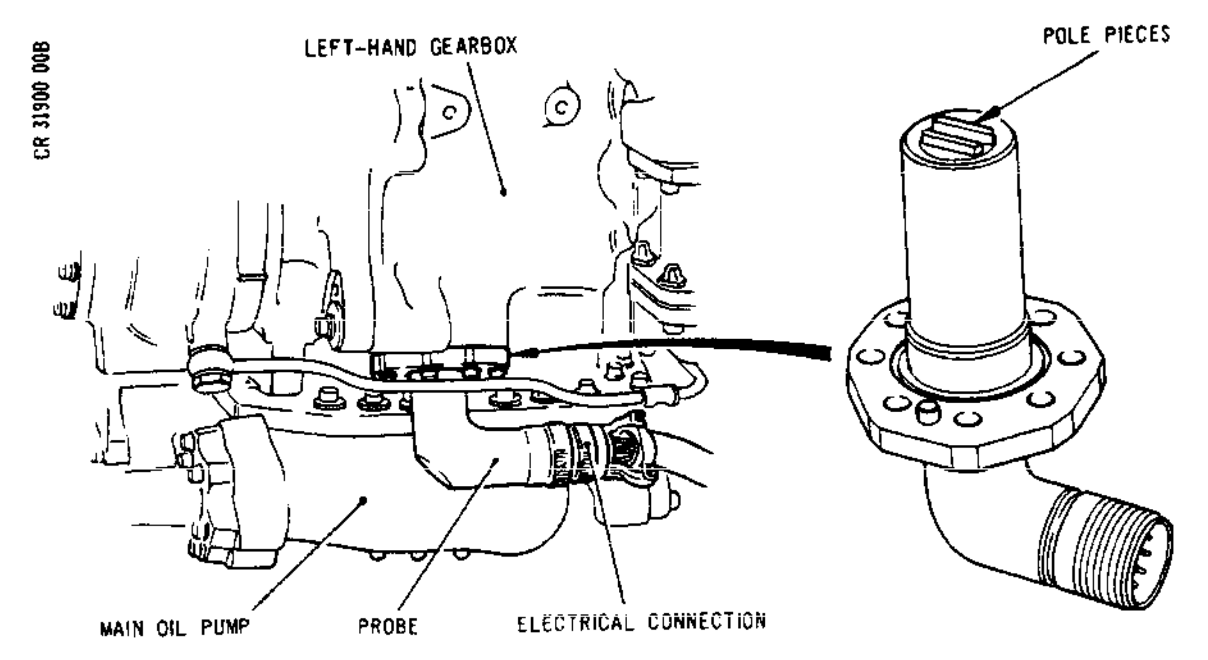
8. Primary Nozzle Controls

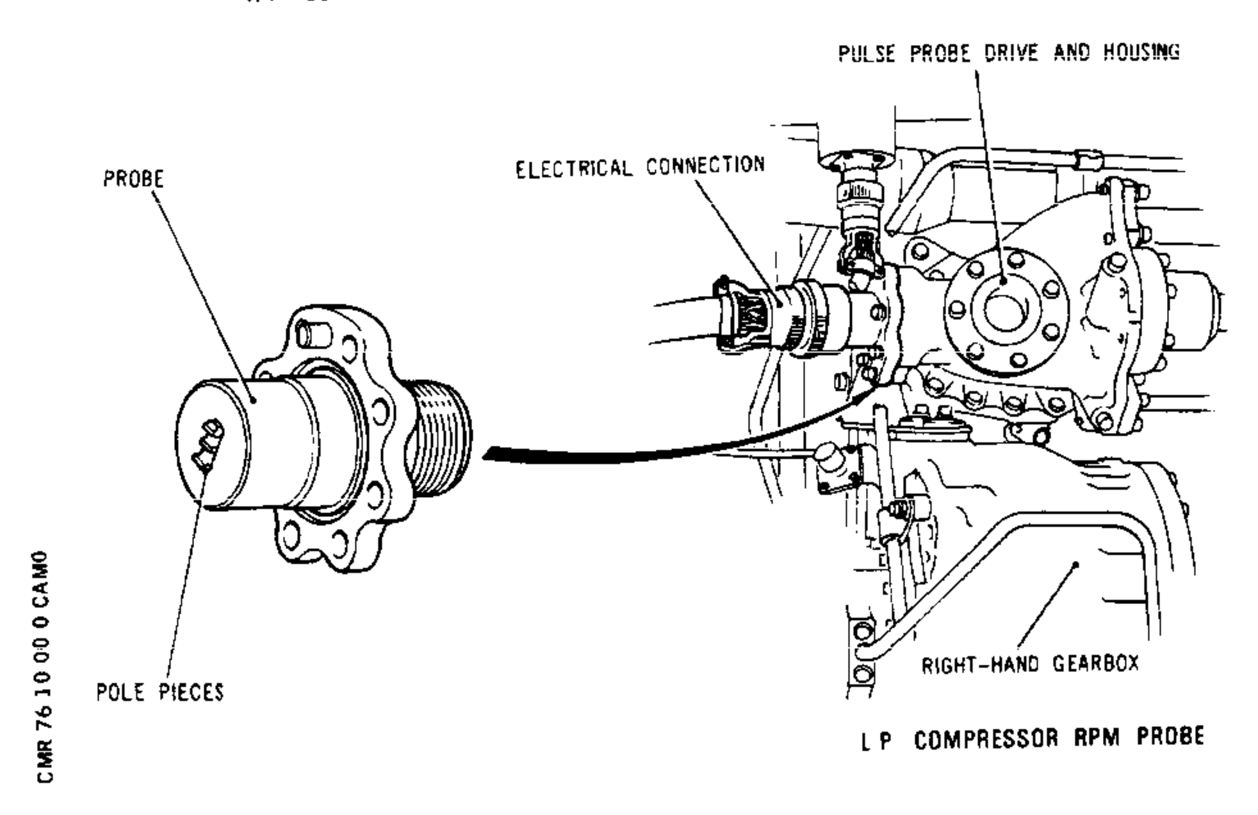
The primary nozzle consists of a ring of petals actuated by pneumatic jacks as described in 78-10-00. The engine control system determines the primary nozzle setting through the operation of the primary nozzle control (PNC) assembly trim unit and pneumatic valve. The control of the primary nozzle area regulates the LP rotor assembly speed N1 to establish a required relationship with the HP rotor assembly speed N2.

The PNC components are mounted on the nacelle wall at the rear of each engine nacelle as shown in the illustration (Ref. Fig. 008). The trim unit is linked electrically to the engine control system and an air connection between the trim unit and the pneumatic valve provides the pneumatic control link. Air tubes connect to the pneumatic valve for the actuating air supply and sensing signals. The trim unit and the pneumatic valve are described in detail in 76-13-11 and 76-13-12 respectively.

The trim unit of the primary nozzle control consists of a gearbox driven by a.c. electric motors, one for each lane of control, main or alternate. The motor effective in control is under the command of its respective control amplifier and drives the gears in response to a control signal to move a cam and position a tapered needle in an orifice. This, in turn, controls a reference pressure Pm that is effective in the PNC pneumatic valve.

The pneumatic valve part of the primary nozzle control assembly is a servo operated valve controlling the actuating





HP and LP Compressor RPM Probes
Figure 007

air to the eighteen pneumatic jacks of the primary nozzle. The body of the valve has a ported bore enclosing a piston and spool valve unit, provides connections for the actuating air tubes and carries the exhaust air outlets. Sensing and reference pressure air connections have separate connections on the valve. P3 air provides the power for jack operation and is also used as a servo and sensing pressure in conjunction with jet pipe pressure air Pj. The reference pressure flow Pm is directed via a tube to the trim unit tapered needle and orifice.

The engine control amplifier maintains the desired N1/N2 relationship through control of the trim unit (Ref. (Ref. Fig. 009). A control signal from the amplifier activates the trim unit which then moves the tapered needle to a new position in its orifice. This results in a change of reference pressure Pm. The reference pressure change causes an out-of-balance condition in the pneumatic valve servo control which moves the piston and spool valve to direct actuating air P3 to the pneumatic jacks. The change in nozzle area continues until the resulting change in sensing pressures restores the balance in the servo control. The piston and spool valve will then hold a steady state condition as long as the N1/N2 relationship, as sensed by the engine control amplifier, is correct.

9. Primary Nozzle Control Signal Pitot

The primary nozzle signal pitot, shown in the illustration (Ref. Fig. 010), is bolted on the outside of the spherical joint flange with its pitot tube projecting inward into the gas flow. An assembly pin in the pitot flange locates the pitot so that the pitot orifice faces upstream.

The signal pitot consists of a pitot and a pitot union assembly that are secured together to the spherical joint flange. The pitot union provides the connection for the pressure signal tube. A restrictor with a filter on each side is retained in the pitot union bore by a ring. A spring and spring plate hold the filter/restrictor pack against the retaining ring.

The pitot senses the gas flow pressure and transmits a pressure signal to a capsule in the primary nozzle control assembly pneumatic valve. The restrictor acts to dampen pressure fluctations.

10. Reheat Flame Detector and Reheat Detection Pressure Switch

The reheat flame detector, (Ref. Fig. 011), is attached to a boss located on the lower left-hand side of the

CR 31901/00B

REFERENCE PRESSURE P_m AIR TUBE

TUBE TO JACKS (CLOSING SIDE)

FORWARD

P_3 SERVO AIR TUBE

ACTUATING P_3 AIR TUBE

JET PIPE PRESSURE P_j TUBE

ELECTRICAL CONNECTIONS

GEARBOX

POSITION AND VELOCITY FEEDBACK SIGNAL

PNC TRIM UNIT

PNC PNEUMATIC VALVE

ACTUATING P_3 AIR

MAIN

SYNCHRO TRANSMITTER

MAIN MOTOR

P_m AIR SPILL

ACTUATING AIR TO ACTUATING JACKS

CONTROL

REFERENCE PRESSURE P_m

ENGINE CONTROL AMPLIFIERS

BRAKE

GEARBOX

SENSING/SERVO P_3 AIR

ALTERNATE

ALTERNATE MOTOR

SYNCHRO TRANSMITTER

JET PIPE PRESSURE SENSING P_j AIR

CMR 76 10 00 0 DAFO

R

Primary Nozzle Control System
Figure 008

CR 34450/00A

REFERENCE PRESSURE P_M AIR CONNECTION

P_3 ACTUATING AIR CONNECTION

TO ACTUATING JACK CLOSING SIDE

PISTON AND SPOOL VALVE

P_3 (SERVO) AIR CONNECTION

SERVO CONTROL

CAPSULE CHAMBER

JET PIPE PRESSURE P_J CONNECTION

CMR 76 10 00 0 DAMO

REFERENCE PRESSURE P_M AIR CONNECTION

ORIFICE PLATE

NEEDLE

CAM

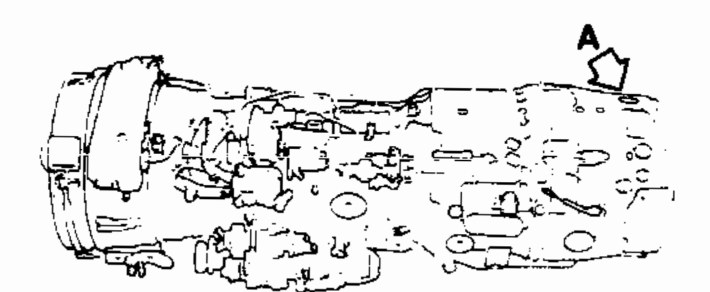
MOTORS

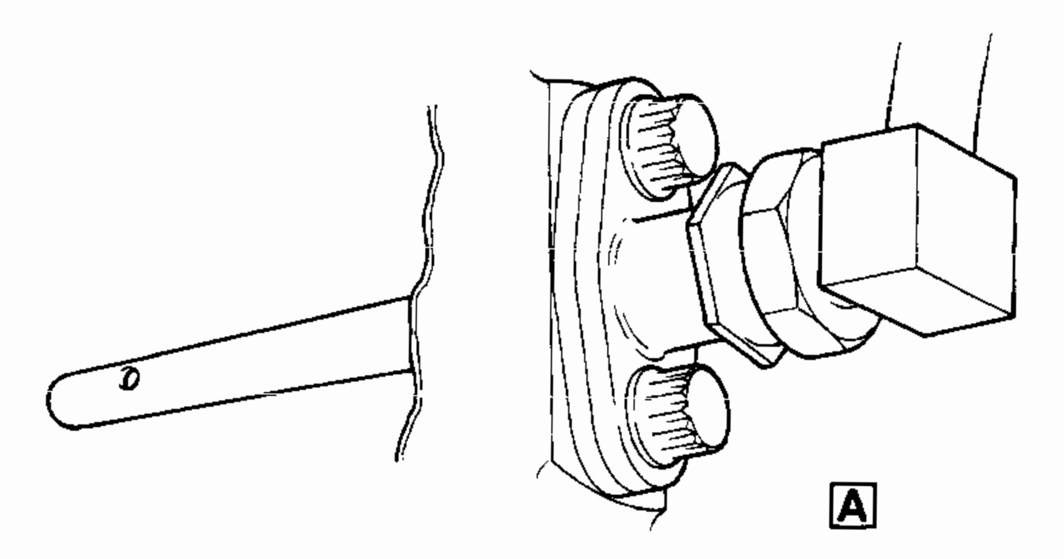
DIFFERENTIAL

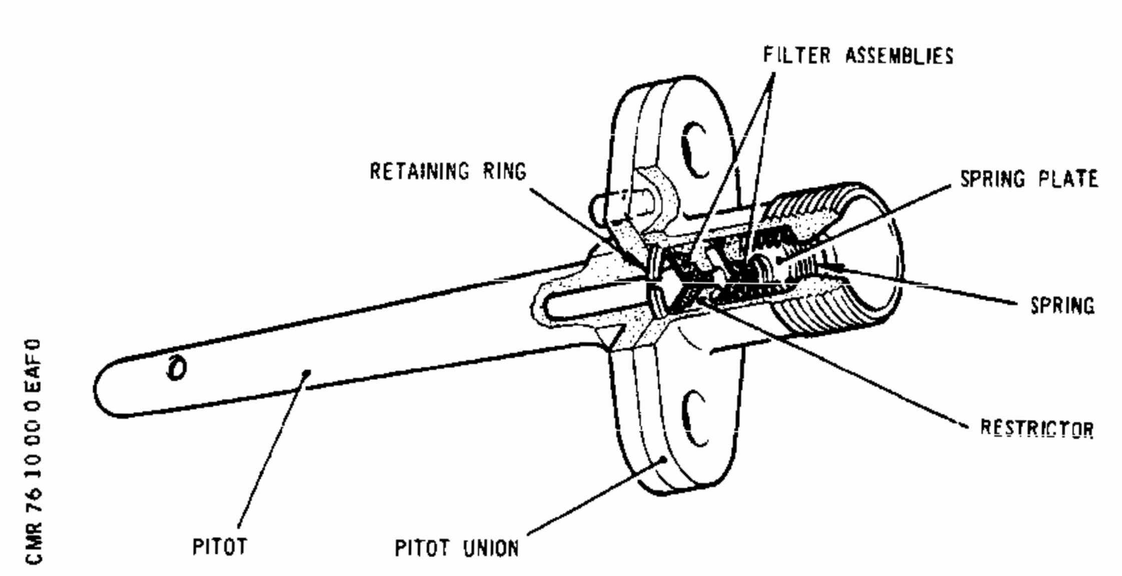
CLUTCH

PNC Trim Unit and Pneumatic Valve
Figure 009

R







Primary Nozzle Control. Signal Pitot
Figure 010

spherical joint flange and projects into the jet pipe downstream from the reheat fuel injection system. The reheat detection pressure switch is located on the upper section of the nacelle wall near the mid position of the jet pipe and connects by tubes to a pressure tapping in the spherical joint flange and another at the primary nozzle.

The two units connect electrically to the reheat control amplifier and transmit signals in response to the operation or inoperation of the reheat system to activate indication captions.

The reheat flame detector consists of a metal rod, insulated by a mica tube and two mica sleeves and retained in a flanged support by a nut. A lead is enclosed in a flexible metallic sheath and insulated from it by 15 ceramic beads. The conical end piece of the sheath is secured to the support by four screws with the lead end attached to the rod retaining nut by a screw. The other end of the lead connects to one pin of a two pin connector with the other pin connected to the sheath. The operating principle of the reheat flame detector is based on the conducting properties of ionized gases which make up the flame. The insulating rod is energized under a voltage of 150 V a.c. As soon as reheat is put in operation, an electric flux flows to ground forming an electric signal fed into the reheat control amplifier to activate the indication.

The reheat detection pressure switch consists of a capsule and a micro-switch contained within a round case that has a mounting flange. Two pressure connections are provided for the pressure tapping tubes and a three pin connector provides electrical connection to the reheat control amplifier. The pressure difference over the capsule holds the switch contacts open when reheat is not operating. When the reheat is lit up the pressure difference changes and the switch contacts close and a signal is transmitted to the reheat control amplifier to activate the indication.

When the detection signals are received by the reheat control amplifier with the aircraft on the ground, the green clear to go (GO) caption light is illuminated. If the signal is not received after sequence T7 then the configuration (CON) light is illuminated instead. When the aircraft is airborne, only the configuration caption light is effective in indication.

11. Reheat Control Amplifier

The reheat control amplifier and its operation is described in 76-15-11 together with its input and output signal

CR 31918'00A

A

ROD

MICA SLEEVES

CONNECTOR

SUPPORT

MICA TUBE

END PIECE

CMR 76 10 00 0 EAMO

A

SHEATH

INSULATING BEADS

PINS

Reheat Flame Detector Assembly
Figure 011

R

relationships. A control amplifier for each engine control system is installed in the rear fuselage racks located in zones 243 and 244 (Ref. Fig. 012). The amplifier is secured in its rack by two hooks located at the front. The rear of the units incorporates a single DPX connector for both power supplies and signals. The amplifier uses 28 V d.c. and 115 V 400 Hz a.c. power. An electrical socket is provided on the front of the unit for the connection of the reheat system test set. A pulse counter near the test socket records the operation of the reheat ignition.

Reheat initiation and operation is under the control of the amplifier subject to a selection being made on the reheat switch and the engine rating mode switch as described in paragraph 17. The amplifier contains the control schedules and limiting circuits for the reheat system.

12. Forward Thrust Switch Pack

The four forward thrust switch packs, shown in the illustration (Ref. Fig. 013), are bolted in pairs on each side of the pilot's centre console support casting. The switch device shaft of each pack engages with the throttle lever assembly.

Each pack consists of a body casting containing two banks of six micro-switches operated, through spring-loaded cam followers, by six double lobed cams keyed to a camshaft. Rotation of the drive shaft causes the camshaft to rotate to operate the switches sequentially.

The switch assemblies are arranged in two rows at 180 deg on the camshaft centre line, switches No.1 to 6 on one side and No.7 to 12 on the other. The switch functions are as follows:

Switch No.	Function
1 and 2	Auto throttle - max. power
3 and 4	Auto throttle - min. power
5	Reheat control (95%)
6	Wheelbrakes
7 and 8	Landing gear warning horn
9 and 12	Air conditioning
10	Reheat control
11	Engine power - auto reduction

Switches No.1 to 6 are radially adjustable through a range of plus or minus 6 deg, switches No.7 to 12 are fixed.

Each switch has coded, numbered leads to identify the switch, the locations being marked on the case. A letter identifies

CR 34587/00A

DPX CONNECTOR

TEST CONNECTOR

PULSE COUNTER

CMR 76 10 00 0 EARO

FRAME 81

NO 3 ENGINE

NO 4 ENGINE

RACK 244

FRAME 71

NO 1 ENGINE

NO 2 ENGINE

RACK 243

R

Reheat Control Amplifier and Location Detail
Figure 012

CR 32556.00A

POSITION INDICATOR

IDLE

A

DRIVE SHAFT

THROTTLE FORWARD SWITCH PACK

MOD.

FIXED SWITCH ASSEMBLY

CAM FOLLOWER

CAMSHAFT

ADJUSTABLE SWITCH ASSEMBLY

SWITCH PACK CENTRE BOLT

SECTION SHOWING ARRANGEMENT OF CAMSHAFT AND SWITCHES

FORWARD

RIGHT HAND SWITCH PACKS

LEVER ASSEMBLY

SWITCH PACKS

PILOTS CENTRE CONSOLE

LEFT HAND SWITCH PACKS

SWITCH PACK CENTRE BOLT

DRIVE SHAFT

DIRECTION INDICATOR

FORWARD

B

CMR 76 10 00 0 EAU0

Forward Thrust Switch Pack and Location Detail
Figure 013

the switch terminal:

A - NC terminal
B - NO terminal
C - C terminal

A bolt, located axially through both camshaft and drive shaft, retains the switch pack to the centre console support.

A pointer, for visual indication of camshaft position is located under the head of the bolt and keyed to the camshaft. To provide for right or left-hand installation, the drive shaft, retaining bolt and indicator can be transferred from one side of the unit to the other. Master splines on the camshaft and drive shaft ensure correct assembly of the parts.

13. Engine Controls, Captions and Indicators

A. General.

The manually operated power controls and associated captions and indicators are located in the flight compartment as shown (Ref. Fig.002 and 014). Power demand is controlled by the pilot's throttle lever position while engine rating selection switches determine some of the limiting parameters to values specific to an engine mode of operation.

Each of the four pilot's throttle levers is manually operated and has a linear movement within a quadrant. The lever position is proportional to engine demand.

B. Throttle Master Switches and Warning Indication.

A throttle master switch for each engine situated on panel 4-211 is a three-position switch with a centre OFF and a MAIN and an ALTERNATE setting. These settings indicate the control amplifier selected to be effective in control for that engine. If a failure in the selected control lane is detected by the safety circuits of its control amplifier, warning captions are illuminated, a single note gong sounds and there is an automatic change-over of the control to the other control amplifier. Two of the warning captions are in red and marked THROT, one is located on the pilot's centre console, panel 9-211 to the rear of the throttle quadrant, and the other, on panel 4-211, the master warning panel. The throttle master switch dolly also illuminates to indicate the failure.

Although there is an automatic change-over of the control

CR 31993/00 C

RELIGHT
OFF
START
ENGINE
DEBOW
NORMAL
DEBOW

A

PANEL 18-214

B

C

A

PANEL 1-214

ENGINE CONTROL SCHEDULE

F/O F/O F/O F/O
HI HI HI HI
MID MID MID MID
LO LO LO LO

NORMAL
FLYOVER (F/O)
APPROACH (MID)
HI
AUTO
LO

WIND DOWN WIND DOWN WIND DOWN WIND DOWN
REHEAT REHEAT REHEAT REHEAT

ENG 4 T/O
N_1 LIMITER
NORM
88%
ENG 1-4
ENG 2-3
HI
LO
GRD IDLE

B

PANEL 27-214

NOZ AIR SOV & WIND DOWN TEST
ENG 1 & 4: D OFF A B C E
ENG 2 & 3: OFF A B C

ENG O/HEAT TEST FIRE & NAC O/HEAT TEST
RESET OFF TC A B C D F1 F2 F3 FLAME
O/HEAT
OFF O/HEAT A B FAULT 1 2 3 4 FIRE

C

CMR 76 10 00 0 FAMA

R

Controls and Captions (Sheet 1 of 2)
Figure 014

CR 31994/00B

CLIMB ENG FLIGHT RATING CLIMB
CRUISE CRUISE

PANEL 4-211

A

B

C

THROTTLE MASTER
ALTERN OFF MAIN ALTERN OFF MAIN

ON AUTO IGNITION ON
OFF OFF

AUTO THROTTLE
ON ON ON ON
OFF OFF OFF OFF

TAKE OFF ENG RATING MODE TAKE OFF
FLIGHT FLIGHT

H.P. VALVE
OPEN OPEN OPEN OPEN

1 2 3 4
SHUT SHUT SHUT SHUT
1 2 3 4

A

PANEL 2-211

PANEL 9-211

CONT.
T/O
CLIMB
CRUISE

B

C

REHEAT

CMR 76 10 00 0 FAMB

1 2 CTY 3 4
RHT
OFF OFF
CTY
ON
OFF
REHEAT CONTROL SWITCH

THROT THROT THROT THROT

Controls and Captions (Sheet 2 of 2)
Figure 014

R

from the selected control amplifier to the other control amplifier, the red warning lights remain illuminated. The master warnings are cancelled by pressing the caption but, in order to extinguish the system warnings, the throttle master switch must be selected to the amplifier now effective in control. A second failure, that of the alternate system, is indicated in precisely the same way, but this time the system warning lights will not extinguish irrespective of switch position. Should the HP fuel valve be opened with the throttle master switch in the OFF position, the failure warning system will activate the master warning system, throttle caption and the throttle master switch dolly will illuminate. The illuminated dolly will extinguish when either a MAIN or an ALTERNATE selection is made.

C. Engine Rating Selectors and Indication.

For each engine, there are three switches effective in the selection of the four ratings of engine operation.

Each set of four switches having a ganging bar across them to permit simultaneous selection.

The ENG RATING MODE switch is located on the pilot's roof panel (4-211) and is a two position switch, labelled TAKE-OFF and FLIGHT. A TAKE-OFF selection makes that rating effective. When the switch is selected to FLIGHT, the engine rating will be a function of the selected position of the second control switch. This switch is held magnetically in the FLIGHT position but the magnetic hold is broken when the aircraft undercarriage is locked down.

The second switch, the ENG FLIGHT RATING switch, is also on the pilots roof panel. This is a two position switch labelled CLIMB and CRUISE and its selected rating will determine engine parameters whenever the ENG RATING MODE switch is selected to FLIGHT.

The third control switch is the reheat selector switch, situated on panel 9-211 immediately behind the throttle box on the pilot's centre console. The three-position reheat switch is labelled CTY for contingency, RHT for reheat and OFF and can only be operated by use of the ganging bar. When this switch is selected to CTY, provided that the ENG RATING MODE switch is in the TAKE-OFF position, the maximum operating conditions of both the engine and reheat will be limited by the con-

tingency rating mode of the engine control amplifier.

The rating switch selections are indicated by a series of captions situated on panel 2-211. These illuminate when each of the four engine ratings are selected. The CONT (Contingency) light is yellow and the other three, T/O (TAKE-OFF), CLIMB and CRUISE are white.

D. Auto Contingency and Indication

During take-off, with reheat (RHT) selected and the take-off monitoring arming push switch set, an automatic selection of the contingency rating is made on all engines should any engine speed fall below 58% N2. When this automatic selection occurs the yellow CONT rating caption will flash continually and the T/O rating caption will remain illuminated. If the reheat selector switch is now set to contingency (CTY) the CONT rating caption illumination will become steady and the T/O rating caption light will extinguish. Selection of all engine reheat switches to OFF will de-energize the take-off monitor arming switch hold-in solenoid, the push switch will go to the off position and auto contingency will be cancelled.

E. Engine Schedule Selectors and Indication

A single ENGINE CONTROL SCHEDULE switch, located on panel 1-214, has three selection positions labelled LO (low), AUTO and HI (high). Each selected position will control the E schedule on all four engines (Ref. Fig. 014). Near to the schedule switch and on the same panel is a programme selector switch. This switch is labelled FLYOVER (F/O), NORMAL and APPROACH (MID) and controls the secondary nozzles through the nozzle angle scheduling unit (NASU) and modifies the E schedules.

Indication of the schedule and programme selection for each engine is provided by four captions marked F/O, HI, MID and LO. The illumination of a caption indicates which E schedule is in control on an engine. The LO captions show green and the others white when lit.

F. Associated Control, Indication and Test Switches.

There are also other switches which have an effect on the engine control function for specific phases of engine operation. An ENGINE DEBOW switch with NORMAL and DEBOW positions and an AUTO IGNITION switch with ON and OFF

positions are provided for each engine. The auto ignition switches have a ganging bar. Two GRD IDLE (ground idle) switches with HI and LO positions serve the four engines, one switch for engines No.1 and No.4 and the other for engines No.2 and No.3. An ENG 4 T/O N1 LIMITER (take-off N1 limiter) switch with NORM and 88% positions is provided for the No.4 engine only. The auto ignition switches are located on the roof panel 4-211 and the ground idle switches and N1 limiter switch are located on panel 1-214. The debow switches are on the starting panel 18-214.

In addition to the indicators and captions that operate in conjunction with the control switches, indicating is provided for the nozzle angle scheduling unit (NASU) controlling the twin secondary nozzles, and the wind-down control. Both junctions have test switches.

The wind-down function of the control system is controlled automatically but test switches are provided on panel 27-214. If a wind-down is imposed on the engine, due to the secondary nozzles moving from the desired position, a yellow warning caption, WIND-DOWN, illuminates. There is a caption for each engine. These captions, located on panel 1-214, will also illuminate when the test switch is used.

The NASU TEST switch and caption lights for the NASU are located at the bottom of panel 1-214. The single caption light is yellow and labelled NOZZLE and the switch has three positions, NASU 1. NORM and NASU 2. The NASU's are selected in turn by switch positions 1 and 2 and the caption illuminates to indicate that the fault circuit of unit under test is serviceable. For normal operation the switch is at the NORM setting and if either NASU should fail, or the air data computer (ADC) signal to it fails, the NOZZLE caption will light up and its outputs will be transferred to the other NASU. Should failure of both NASU's occur, the failure will be indicated in the same manner. In this event, with E schedule switch at E AUTO, the NASU will automatically select E LOW. A separate warning on the face of NASU provides local indication of failure.

The NOZZLE caption will also light up if the programme selector switch is left in FLYOVER when the aircraft speed exceeds M1.0. Selection of the programme selector switch to NORMAL, in these circumstances will extinguish the NOZZLE caption.

Should the exhaust gas temperature (EGT) signal to the

selected control lane fail, a yellow warning illuminates on the bezel of the EGT indicator. When the warning illuminates, the maximum governed N2 is reduced to ensure that maximum permitted EGT is not exceeded.

14. Operation of the Power Control System

Fuel flow to the engine combustion system passes through the HP fuel shut-off valve in the FCU which gives a direct control of the engine fuel supply. The valve position is selected by the HP FUEL switch and must be open for the engine to run. Because a controlled fuel pressure drop acts across the throttle valve orifice, the rate of fuel flow to the combustion system is controlled by the throttle valve setting and establishes the HP rotor assembly speed, N2, which is the main engine parameter determining engine power. The throttle valve is positioned by the engine control system to act in the fuel control loop of the FCU. The fuel control system operation is described in 73-20-00.

There is an optimum LP and HP rotor assembly speed relationship (N1/N2) for every value of fuel flow and operating condition. Throughout the range of engine operating conditions this relationship establishes an engine running line known as the engine control E schedule.

In each engine control channel, the throttle master switch selects the lane to be effective in control and the pilot's throttle lever angular setting determines the power demand. The rating switches and reheat switch, together with the control schedule switches, determine the engine operating mode in which an engine running line and a maximum speed datum are set specific to the existing operating conditions. The power demand and rating mode signals are computed with monitored operating signals by the selected control amplifier whose operation is described in more detail in 76-11-11. In response to the input signals, the control amplifier transmits controlling outputs to adjust the engine fuel system throttle valve and primary nozzle setting to meet the power demand within the operations limiting parameters. The reheat control amplifier regulates the reheat fuel controller within a selected engine rating when a reheat selection is made. Both these systems are shown in the illustration (Ref. Fig. 015).

There are three spheres of control in the electrical power control system:

Engine fuel flow control by means of the throttle valve actuator gearbox.

Primary nozzle area control by means of the PNC trim unit.

Reheat fuel flow be means of the reheat fuel controller.

In the selected lane, the control amplifier activates the throttle valve actuator gearbox and controls N2, the primary parameter of engine operation, as described in paragraph 15. The amplifier control of the PNC trim unit, and consequently N1, is given in paragraph 16 while the reheat control sequence is given in paragraph 17.

15. Operation - Control of the Throttle Valve Actuator Gearbox and N2

A. General

The input signals to the control amplifier for the control of N2 are:

Governing and positioning from the throttle lever transmitter.
HP rotor assembly speed, N2.
Throttle valve actuator gearbox position and rate.
Intake total air temperature, T1.
Exhaust gas temperature, EGT.
Freestream total air pressure, P infinity.
Ambient temperature, t alpha.

B. Control Loops.

The engine control operates through basic control loops which activate the throttle valve actuator gearbox. The control loops cover the full range of engine operation with only one loop effective in control at any time. In addition to the basic loops, there are limiting networks which ensure that the engine operates smoothly and within safe limits. The operating limits include a maximum N2 limitation and a maximum turbine entry temperature limitation which is referenced to intake air temperature, T1, and exhaust gas temperature, EGT.

To control the engine and meet the required N2 selected by the pilot, an N2 governing loop is used in as wide a control band as possible. The governing loop maintains a demanded N2 by regulation of the fuel flow to compensate for changes in ambient conditions. Because it is desirable that the thrust produced in the lower range of engine rpm should be the lowest obtainable without reducing N2 to a level where rotating stall could occur, an N2/root theta governing loop is used in this range.

MAIN LANE
ALTERNATE LANE
CR 32598/00B
ACTUATOR GEARBOX
PNC TRIM UNIT
ENGINE CONTROL AMPLIFIER (MAIN)
ENGINE CONTROL AMPLIFIER (ALTERNATE)
POWER SUPPLY
28v DC
115v 400Hz
SENSING SIGNALS
T_1, N_2, N_1
Pa ta
AUTO N_1 REDUCE
TO REHEAT CONTROL AMPLIFIER
REHEAT CONTROL
WIND DOWN AND BUCKET SWITCH SIGNALS
CMR 76 10 00 0 GAMA
NASU
ENGINE FLIGHT RATING
PILOTS THROTTLE CONTROL TRANSMITTER
THROTTLE MASTER
NORMAL ENGINE CONTROL SCHEDULE
TO REHEAT CONTROL AMPLIFIER
ENGINE RATING MODE
AUTO IGNITION
ENGINE DE-BOW
ENGINE STARTING
GROUND IDLE

Basic Control - Diagrammatic (Sheet 1 of 2)
Figure 015

R

CR 32683/00B

REHEAT CONTROL AMPLIFIER

REHEAT PURGE AIR SOLENOID

POWER SUPPLIES
28V D.C.
115V 400 Hz

REHEAT CONTROL SWITCH

FIRE SWITCH

REHEAT FUEL FLOWMETER

Fr

THROTTLE SWITCH

REHEAT CONTROLLER

METERING VALVE MOTOR

TO IGNITERS

SAFETY RELAY

IGNITION RELAY (74-00-00)

SENSING SIGNALS

REHEAT DETECTOR (IONISATION)

REHEAT LIGHT-UP
PURGE VALVE POSITION
N_1
T_1

Fe

ENGINE FUEL FLOWMETER

REHEAT DETECTION PRESSURE SWITCH

CMR 76 10 00 0 GAMB

Basic Control - Diagrammatic (Sheet 2 of 2)
Figure 015

R

Since the fuel flow required to maintain a demanded N2 decreases with increase in altitude, the fuel flow could, for low rpm at high altitude, become too low to maintain combustion and result in flame extinction. Because of this, a positioning loop is made effective in control under these conditions.

In the theoretical control loop shown in Figure 16, the pilots' N2 demand signal is compared with the datum N2 signal by the lowest wins network and the signal demanding the lowest N2 will be the output, N2 demand signal. This N2 demand signal is compared with a signal referenced to the actual N2 of the engine. If the two signals are the same, the engine is at the required speed and there would be no effective control signal output as long as this steady state condition continues. A difference between the signals would result in an effective control signal output in a sense to correct the engine speed until the signal difference was eliminated and the steady state restored.

The action of the limiting networks of the control amplifier is, in general, to compare and discriminate between signals and provide a corrective output signal as shown in the pilots' demand loop logic.

C. Governing Demand Loop (Ref. (Ref. Fig. 016)

In N2 governing loop of the control amplifier, the actual N2 speed signal, transmitted by the HP compressor rpm probe, is compared with the governing N2 demand signal determined by the pilot's throttle lever position. Movement of the pilot's throttle lever would alter the demanded N2 signal and cause the actual and demanded N2 to differ. Provided that no limiting signals are effective, this will result in a control signal in a sense to drive the actuator gearbox and adjust the fuel flow until the actual and demanded N2 are the same. The steady state condition will then again be established. While the engine is operating in the governing range the governing loop maintains the demanded N2 constant by regulation of the fuel flow.

The HP rotor assembly rpm can be increased in response to demand until a limiting control is invoked.

In any selected engine rating, a maximum datum signal demands an N2 that holds the turbine entry temperature within a required operational limit while the maximum N2 limit signal demands the N2 that is the maximum acceptable

HP rotor speed. Should a change of pilot's lever setting demand an N2 higher than either or both of the two limiting signals, then the signal with the lowest N2 demand becomes effective in control. The engine accelerates until the actual N2 balaces this effective control signal and a steady state condition ensues. The other two signals could still be demanding an increase in N2 but the lowest wins network renders then ineffective.

D. N2/root Theta Governing Demand Loop.

The N2/root theta governing loop of the control amplifier uses a reference signal, N2/root theta, that is derived from an actual N2 signal and a signal from the T1 probe. The reference signal is compared with the demand signal generated by the pilot's throttle lever position and any difference between the two signals will result in a correcting control signal.

A limit is imposed on the minimum engine speed when this control loop is effective in control as described in paragraph G, minimum idle N2 datum.

E. Positioning Demand Loop.

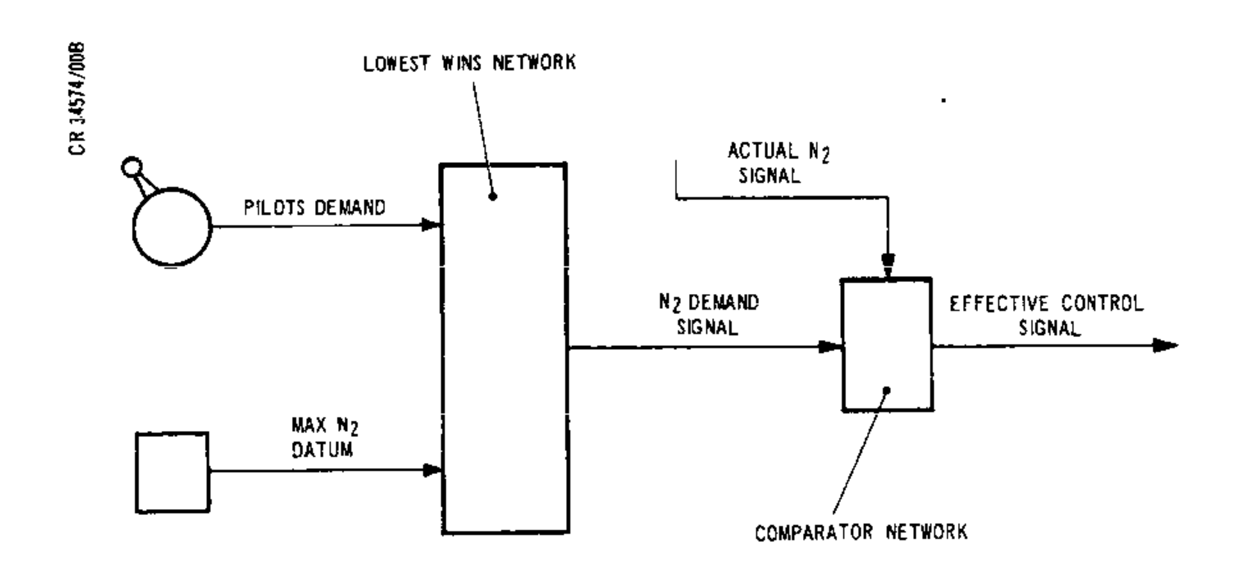
The positioning loop of the control amplifier receives a position feedback signal transmitted by the synchro transmitter of the actuator gearbox of a value relative to the actual position of the throttle valve. This signal is compared with the positioning demand signal of a value determined by the pilot's throttle lever setting. If the engine is operating in the positioning range, the throttle valve setting will be directly related to that of the pilot's lever with the two signals in balance. The fixed throttle valve setting maintains the fuel flow rate constant and N2 will vary in response to changes in the ambient conditions increasing with increase in altitude.

F. Pilot's Demand Logic (Ref. (Ref. Fig.016 and 017)

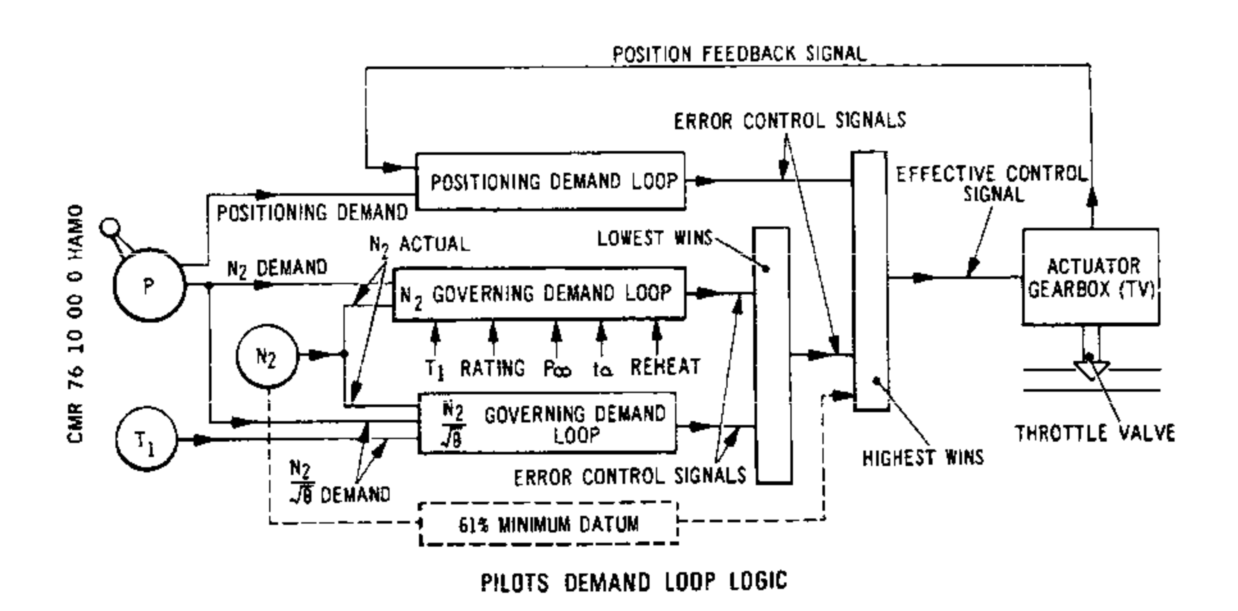
Although the three basic control loops are continuously activated only one can be effective in control at any time. Three factors dictate the choice of the control loop to be made effective in regulating the throttle valve.

Control at high power settings must always be by an N2 governing system.

At altitude, the fuel flow must be prevented



THEORETICAL CONTROL LOOP



PILOTS DEMAND LOOP LOGIC

R Engine Control Basic Loops

Figure 016

from reducing to the point where flame extinction could occur.

At ground level, idle rpm must be as low as possible within rotating stall limitation.

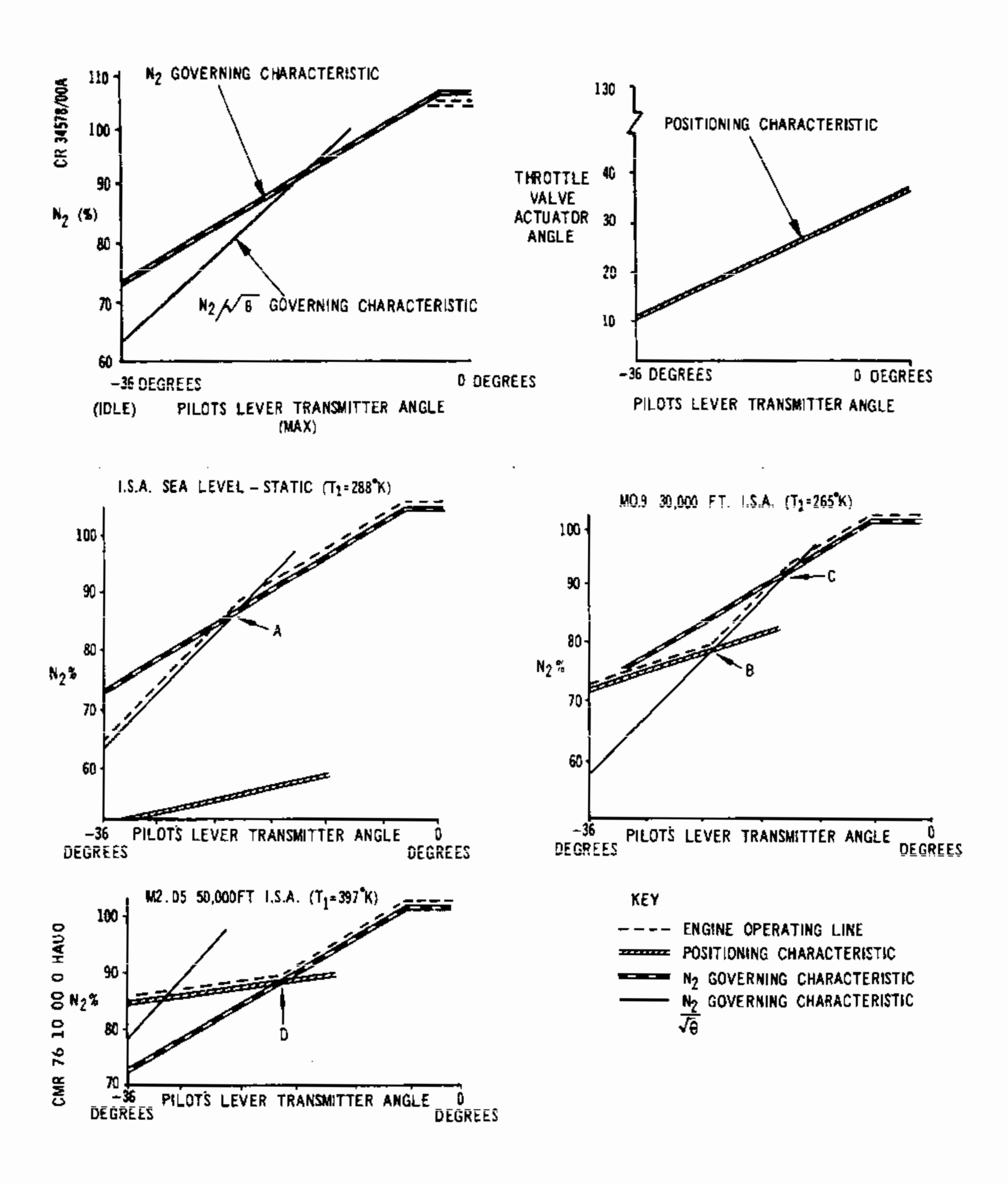
The error signals from the N2 and N2/root theta governing demand loops are fed to the lowest wins network which transmits the signal demanding the lowest N2 to the highest wins network. In this network the signal is compared with the error signal emanating from the positioning demand loop. The signal demanding the highest N2 is selected to be the effective control signal to drive the throttle valve actuator gearbox motor.

While the engine operating condition meets the demand of the effective control loop, there will be no control signal transmitted to the actuator gearbox, the throttle valve setting will be maintained and a steady state condition will exist. A change in power demand, made on the pilot's lever, or a change in operating or ambient conditions, would upset the state of balance in the control loops. The resulting change in the error signals would necessitate regulation of the throttle valve to establish a steady state condition. With this change of values, there could also be a change of effective control loop. The three control loop characteristics, showing N2 in percentage for a given angle of pilot's lever transmitter pick-off, are shown for three conditions of operation in the illustration (Ref. Fig. 017).

G. Engine Operation Limiting Networks.

The control loops permit the pilot to use the throttle lever to make any desired power demand within the maximum rpm limit determined by the selections made on the rating switches. Although a rapid response is required, limiting and control circuits are needed to modify the pilots demand to prevent any safe limit of engine operation being exceeded. Each limiting factor overrides the pilots control and acts automatically in either the engine starting phase, debow control, minimum idle limitation and acceleration and temperature limitation. The electrical control system also includes control for functions other than power demand.

Debow control:



Pilot's Demand and Engine Running Line
Figure 017

R

During the period after engine shut-down, uneven cooling rates of the high pressure compressor assembly cause a slight bowing of the shaft. If the engine is to be re-started during this period, it is essential that the HP shaft is unbowed before the engine is allowed to accelerate up to idle rpm. This straightening of the shaft is achieved by passing airflow through the engine at low rpm to even out the temperature of the HP shaft prior to accelerating up to idle rpm.

Prior to engine starting, DEBOW is selected on the control switch and a signal to the lowest wins network overrides the pilots demand signal and restricts the N2 to approximately 30% for the required length of time.

Starting phase:

A start control schedule is used to ensure that the correct fuel/air ratio for starting is obtained. A 67/58% N2/root theta switch mutes the control demand signal and makes this schedule effective in control until the engine has accelerated to 67% N2/root theta. When the engine decelerates to 58% N2/root theta the switch again imposes the start schedule. The following limiting controls are effective during the engine starting and relighting phase:

The debow control
The 67/58% N2/root theta switch
The start control schedule
The minimum idle N2 datum
A lower rate of temperature rise control of starting and relighting

Minimum idle N2 datum:

A signal is passed to the highest wins network demanding a minimum N2 of 61% to ensure that the rotational speed of the integrated drive generator does not fall too low to maintain the required output frequency.

Acceleration rate control:

The acceleration rate of an engine is a function of the rate of adding fuel and must be fast without initiating a surge condition. The acceleration rate control permits a direct throttle lever control only over acceleration rates of less than an imposed maximum limit.

Deceleration rate control:

During deceleration, there is only full control by the throttle lever of deceleration rates of less than an imposed limitation.

Exhaust gas temperature (EGT) control:

A maximum temperature control is imposed to ensure that the temperature at the turbine blades does not exceed a safe limit. Jet pipe thermocouples sense EGT and transmit a signal for comparison with a maximum temperature datum, referenced to EGT and intake air temperature T1. If the maximum EGT is reached, the limiting control signal becomes effective.

A rate of temperature rise control ensures that the maximum temperature limit is not exceeded by slowing the rate at which the temperature approaches the maximum.

A lower rate of temperature rise schedule and a maximum EGT start datum are made effective for engine starting and relighting.

R The two position EGT switch of an A6A16/24DC amplifier is
R set to select the maximum temperature and EGT start datums
R appropriate to the type of combustion chamber in the
R engine. A position 1 (up) switch setting gives the same
R datums as the /24CA and /24CC amplifiers whereas the
R position 2 (down) switch setting gives the datums appli-
R cable to the 2BR standard combustion chamber.

H. Ancillary Control Functions.

The engine electrical control system includes the following control functions to meet specific conditions of engine operation other than in the normal propulsion power control phase.

For relight during flight, initiation of ignition is prevented unless the throttle lever is at the idle setting and giving the correct fuel/air ratio for light-up. An automatic relight facility is provided to reduce the fuel flow to the rate required for light-up before initiation of ignition and ensure that an engine is relit quickly after any unscheduled flame-out. The auto ignition control senses a flame-out, positions the throttle valve and primary nozzle and then initiates ignition. The system cancels its control when the engine is relit and operating. A reverse thrust N2/root theta governing schedule is used to control the engine rpm as a function of the reverse thrust lever when reverse thrust is in operation. An automatic wind-down circuit reduces

engine power to a minimum should the buckets move away from their selected positions.

Reverse thrust is selected in flight on No.2 and No.3 engines only with all throttle levers at idle. To ensure that the P3 air is adequate for the bucket operation, No.1 and No.4 engines that supply the air have their idle rpm increased.

16. Operation of the E Schedule - Control of N1

A. General

The optimum engine performance for every value of N2 within the surge limitation can be obtained by control of the N1/N2 relationship. Control of fuel flow regulates N2 whereas control of the primary nozzle area is used to regulate N1 in respect of the N2 obtained. This control of N1 establishes an N1/N2 relationship and is the E schedule control.

Engine running lines that would apply for the nozzle conditions of fully open (AJ max) and fully closed (AJ min) are shown in (Ref. Fig. 018). Selected engine running lines which give the optimum N1/N2 relationship for different conditions of engine operation lie between these two extremes.

The basic E schedule, shown in (Ref. Fig. 018) consists of three engine running lines E6, E1 and E4 and relates to an ENGINE CONTROL SCHEDULE switch selection of HI (high). The E high control gives the best engine performance for cruise conditions. Other E schedules, E2, E5 and E7, are used to impose control schedules to comply with the requirements of other aircraft flight conditions and reheat operation. Limiting networks are used to ensure that the PNC control keeps the engine running within safe operating limits.

The switch control functions are shown as logic sequences in (Ref. Fig. 020). The E schedule running lines that are made effective in control by the switches are shown in (Ref. Fig. 019) and described in paragraph D.

B. Basic E Schedule

Input signals to the control amplifier from the LP and HP compressor probes and the T1 temperature probe, N1,N2 and T1, are computed to provide an N1/root theta and an N2/root theta to the E schedule network. This network uses N2/root theta as a datum and compares the actual N1/root theta

ICR 34576/00A

100
95
90
85
80
75
70
65
60
55

$N_1/\sqrt{\theta}$ IN %

THE E SCHEDULE

LP SURGE BOUNDARY

E4

NOZZLE OPEN LINE (AJ MAX)

E1

HP SURGE BOUNDARY

E6

NOZZLE CLOSED LINE (AJ MIN)

75 80 85 90 95 100 105 110

$N_2/\sqrt{\theta}$ IN %

CMR 76 10 00 0 JAFO

PULSE PROBE

N_2

TEMPERATURE PROBE

T_1

PULSE PROBE

N_1

$N_1/\sqrt{\theta}$ AND $N_2/\sqrt{\theta}$ NETWORK

$N_2/\sqrt{\theta}$ ACTUAL

$N_1/\sqrt{\theta}$ ACTUAL

E SCHEDULE NETWORK

E SCHEDULE N_1 ERROR SIGNAL

M

PNC TRIM ACTUATOR

Basic E Schedule Control Loop
and Running Line
Figure 018

R

value with that demanded by the E schedule. Any difference in value generates an error signal in a sense to drive the PNC trim unit to adjust the primary nozzle area.

The pneumatically operated primary nozzle control system will reset the nozzle area until the actual N1/root theta system is in balance with the desired N1/root theta signal and the error signal is cancelled. In this steady state condition, the engine would be complying with the basic E schedule running line.

C. Other E Schedules.

At low aircraft speeds, the basic E schedule of E high (HI) does not give enough LP surge boundary margin and an E low schedule is used. E low imposes the regime of the running lines E6 and E7. Acceleration on this E low schedule determines a relatively lower N1/root theta for a given datum N2/root theta than the basic E high schedule and ensures adequate LP surge boundary margin as shown in the illustration (Ref. Fig. 019).

During flight with the reheat operating, the selection of and E mid schedule imposes the regime of the running lines E6, E2 and E5. This E mid schedule also demands a lower N1/root theta for a given datum N2/root theta than the E high schedule and has the affect of reducing the mass airflow.

The E mid schedule is also used during the approach phase of aircraft flight. The control imposed by the E6,E2 and E5 regime requires a larger primary nozzle area than the E low schedules which has the affect of reducing the noise level.

When noise abatement is required during the aircraft climb after take-off, an E flyover schedule is selected which imposes the regime of the E6 and E1 running lines. The E flyover schedule ensures that the engine operates with a open primary nozzle thereby reducing jet exhaust velocity and associated noise to a minimum.
and Schedule Limiters

D. E Schedule Selections

The ENGINE CONTROL SCHEDULE switch and programme selector switch provide for selection of the E schedule to be effective in control either directly or through the nozzle, angle scheduling unit NASU (Ref. Fig. 002).

The ENGINE CONTROL SCHEDULE switch has the position of HI,

CR 32614/00C

MAX $N_2/\sqrt{\theta}$ LIMITER

$N_1/\sqrt{\theta}$ LIMITER

E4

LP SURGE BOUNDARY

E5

E7

$N_2/\sqrt{\theta}$ LIMITER SCHEDULE (E3)

E1

E2

HP SURGE BOUNDARY

E6

NOZZLE OPEN LINE

NOZZLE CLOSED LINE

$\frac{N_1}{\sqrt{\theta}}$ % (50, 60, 70, 80, 90, 100)

$\frac{N_2}{\sqrt{\theta}}$ % (60, 70, 80, 90, 100, 110)

E SCHEDULES

E	LOW:	E6 – E7 – $N_1/\sqrt{\theta}$ LIMITER
E	HIGH:	E6 – E1 – E4 – $N_1/\sqrt{\theta}$ LIMITER
E	MID:	E6 – E2 – E5 – $N_1/\sqrt{\theta}$ LIMITER
E	FLYOVER:	E6 – E1 – $N_1/\sqrt{\theta}$ LIMITER

CMR 76 10 00 0 JAMO

E Schedule Running Lines, Selections
Figure 019

LO and AUTO. An HI selection will select the E high schedule which becomes effective in control provided the undercarriage is not locked down and operating the mating undercarriage down lock switch. Otherwise control remains on the E low schedule. The E low schedule is selected by the switch in the LO setting. An AUTO selection arms the NASU as an automatic selector for E high, E low, E mid or E flyover in response to further input signals. These additional signals are from the air data computer in respect of an air speed in excess of 220 knots and a power reduce network which has inputs from the pilot's throttle lever transmitter and the reheat selector switch. The schedule selection is made by the NASU as a function of the combined input signals.

Each of the three programme selector switch positions, FLYOVER (F/O), NORMAL and APPROACH (MID) feeds a signal to the NASU which transmits the relevant E schedule selection signal to the effective control amplifier.

The NORMAL selection transfers the E schedule selection function via the NASU to the ENGINE CONTROL SCHEDULE switch while the other two selection inputs to the NASU result in signals to the effective control amplifier to make either the E mid or the E flyover schedules effective in control.

A signal from the reheat selector switch will select the E mid schedule provided that the ENG RATING MODE switch is selected to FLIGHT.

E. Limiting Networks.

In a similar manner to the fuel control circuit, limiting networks are provided in the primary nozzle control circuit to ensure that operating limitations are not exceeded. These limitations are adjusted in certain circumstances to comply with aircraft flight requirements.

Limiting signals act on fuel control and primary nozzle control to avoid LP and HP surge, maintain engine/intake matching and regulate response and opening limits of the primary nozzle. These limiting networks are:

N2/root theta and E3 limiter	-	avoids HP surge by fuel control
N1/root theta limiter	-	avoids LP surge by control of nozzle

CR 32590/008

E SCHEDULE SELECTOR SWITCH
HIGH
AUTO
LOW
U/C DOWN LOCK SWITCH
HIGH
AIR DATA COMPUTER
PROGRAMME SELECTOR
FLYOVER
NORMAL
APPROACH
NOZZLE ANGLE SCHEDULING UNIT
FLYOVER
MID
P
POWER REDUCE
REHEAT SWITCH
E SCHEDULE SELECTOR
FLIGHT DECK INDICATIONS
TAKE-OFF
FLIGHT
RATING SELECTOR
N_2
T_1
N_1
$\frac{N}{\sqrt{\theta}}$ NETWORK
$N_2/\sqrt{\theta}$
$N_1/\sqrt{\theta}$
E SCHEDULE NETWORK
(E_e)
NOZZLE TRIM ACTUATOR
AUTO $N_1/\sqrt{\theta}$ REDUCE

CMR 76 10 00 0 JAU0

E SCHEDULE SELECTION

E Schedule Control
Figure 020

Auto N1/root theta reduce	-	acts to reduce N1/root theta limit to maintain engine/intake matching
Max N1 governor	-	acts to limit N1
Max N1 fuel control	-	avoids excessive N1 speeds caused by nozzle malfunction
PNC trim actuator position limiters	-	prevent delay in response and overrun of the PNC trim actuator and apply limits related to engine operating condition
Reverse thrust	-	acts to override the E schedule and close the nozzle when reverse thrust selection is made

F. System Safety.

The electrical control system that has been described in this section is, for safety reasons, duplicated for each engine. Each control lane is completely separate, each having a.c. and d.c. supplies from different busbars and its own engine control amplifier receiving separate control and sensing signals.

Within each control amplifier is a system of safety circuits which continuously monitor the electrical integrity of the control lane. Should any failure affecting safe operation be detected within the control lane controlling the engine, a warning is activated and an automatic changeover to the other control lane is initiated.

R When the fault identification module (FIM) is incorporated
R and made effective, the failure, with some exceptions, will
R cause the indicators to illuminated in the code combination
R appropriate to the defect. The four indicators are
R numbered 1, 2, 4 and 8 and the code for a fault is the
R summation of the values of the illuminated indicators.
R In addition to the indication, the module will store the
R fault code in a memory circuit and retain it even if the
R amplifier is switched off.

17. Operation of the Reheat Control System

A. General (Ref. Fig. 021).

The reheat system provides additional thrust to achieve the required total thrust (dry engine thrust plus reheat thrust). Reheat is used at take-off, during transonic climb, in case of an engine failure (climb with one engine failed, approach with two engines failed). Within the limitations of the reheat system itself, the amount of fuel that can be burnt in the jet pipe depends on dry engine conditions.

Fuel is delivered from the first stage fuel pump to a reheat fuel controller which meters the fuel entering an injection system located in the jet pipe. Overall control is effected by a reheat control amplifier which includes control schedules and limiting networks.

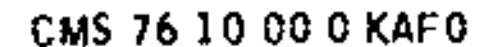
The reheat fuel controller is described in 73-23-01. The fuel, applied from the first stage pump, flows through a reheat flowmeter, fuel metering valve, shut-off valve and purge valve to the injection system.

Fuel from the reheat controller is delivered to an injection assembly attached to the engine exhaust diffuser bullet. Fuel ignition is achieved by a high voltage arc igniter fed from a transformer. Excitation of the transformer is controlled by the reheat control amplifier. Confirmation of reheat light-up is sensed by a flame detection system which gives a flight deck indication. Should reheat flame fail to be detected, an amber CON caption will illuminate.

B. Operation of the Reheat Control System.

Control of reheat operation is achieved by the reheat control amplifier (Ref. Fig. 022). This unit includes various control schedules and limiting circuits to control reheat fuel flow as a function of dry engine operation. The amplifier is supplied with 28 V d.c. and 115 V a.c. 400 Hz and is armed by operation of a reheat selector switch. Reheat operation is achieved providing: the engine shut-down handle is not operated, the pilots' forward throttle lever 10% switch is made and the LP compressor rpm (N1) is greater than 81%.

The reheat fuel flow (FR) is scheduled as a function of dry engine fuel flow (FE) and engine inlet temperature (T1). This provides the required total thrust irrespective of change in engine inlet temperature (T1). To cater for various engine operating conditions, the FR/FE scheduled relationship is altered by a flight deck rating selection. Two flame detection signals and a purge valve position signal complete the input signals to the amplifier.



T1
N1
INJECTION SYSTEM
INGNITER
1ST STAGE PUMP
FLOWMETER (F_E)
5TH STAGE H.P. AIR
FLAME DETECTION SYSTEM
PILOTS THROTTLE LEVER
FLOWMETER (F_R)
PURGE VALVE SOLENOID
REHEAT CONTROLLER
REHEAT CONTROL AMPLIFIER
FUEL METERING VALVE
SHUT-OFF VALVE
PURGE VALVE
REHEAT SELECTOR SWITCH
IGNITION TRANSFORMER
FLIGHT DECK INDICATIONS
REHEAT
CON
REHEAT "ON" LIGHT

Basic Reheat System
Figure 021


EFFECTIVITY: ALL

R

BA

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The reheat control amplifier determines the operation of the metering valve and the shut-off valve within the fuel controller, and the purge valve solenoid. Output signals also energize the reheat ignition and safety relays. Two signals are fed from the reheat control amplifier to the engine control unit to facilitate safe dry engine and reheat operation. Output signals also provide for flight deck indication.

Reheat control is electronically achieved by means of servo loops (Ref. Fig. 023). A signal FR/FE from the take-off schedule, the value of which is a function of T1, is fed into a multiplier (M1), the second input of which is the actual dry engine fuel flow FE. The output of the multiplier is the reheat fuel flow demand signal FRd. This signal is compared to the actual reheat fuel flow signal FR in a summer S1, the output of which is the algebraic sum of the two inputs and constitutes an error signal FRe. The error signal drives the fuel metering valve motor through an amplifier. A velocity feedback system is used to provide servo loop stability. When the actual fuel ratio FR/FE is on schedule, the fuel demand signal FRd is equal but opposite in sign to the actual reheat fuel flow signal provided by the reheat flowmeter. Their algebraic sum is therefore zero and the metering valve remains stationary.

If T1 increases, FR/FE must also increase to satisfy the schedule. In that case, the FRd signal becomes more positive and its absolute value now exceeds that of the actual fuel flow FR. The output from the summer is positive and the metering valve opens. The actual reheat fuel flow is increased and the signal issued from the reheat flowmeter to frequency d.c. converter increases until the modules of both inputs to summer S1 are again equal. The metering valve remains stationary on its new position and the FR/FE is on schedule. Should the dry engine fuel flow change, the metering valve position will alter to re-establish the requisite FR/FE relationship.

Other schedules are provided to control reheat fuel flow, to comply with the requirements for various engine operating conditions, the basic operation of the control loop remaining unchanged.

Contingency Schedule:

In case of one engine failure at take-off or two engine failure during approach, a CONTINGENCY rating may be selected. This selection introduces a CONTINGENCY SCHEDULE


CMS 76 10 00 0 KAMO

ENGINE INLET TEMPERATURE (T_1)
DRY ENGINE FUEL FLOW (F_E)
REHEAT FUEL FLOW (F_R)
IONISATION PROBE
REHEAT DETECTION PRESSURE SWITCH
PURGE VALVE POSITION
L.P. COMPRESSOR R.P.M. (N_1)
FLIGHT
TAKE-OFF

REHEAT
CONTROL
UNIT
RV 884

28V d.c.
115V a.c. 400Hz
ENGINE CONTROL UNIT
P_M BOLT
'E' SCHEDULE
FUEL METERING VALVE MOTOR
SHUT-OFF VALVE SOLENOID
PURGE VALVE SOLENOID
SAFETY RELAY
IGNITION RELAY
CONFIGURATION LIGHT
FAILURE LIGHT "REHEAT"
REHEAT SELECTED LIGHT

SHUT DOWN HANDLE
CONTINGENCY REHEAT OFF
THROTTLE LEVER 10% SWITCH

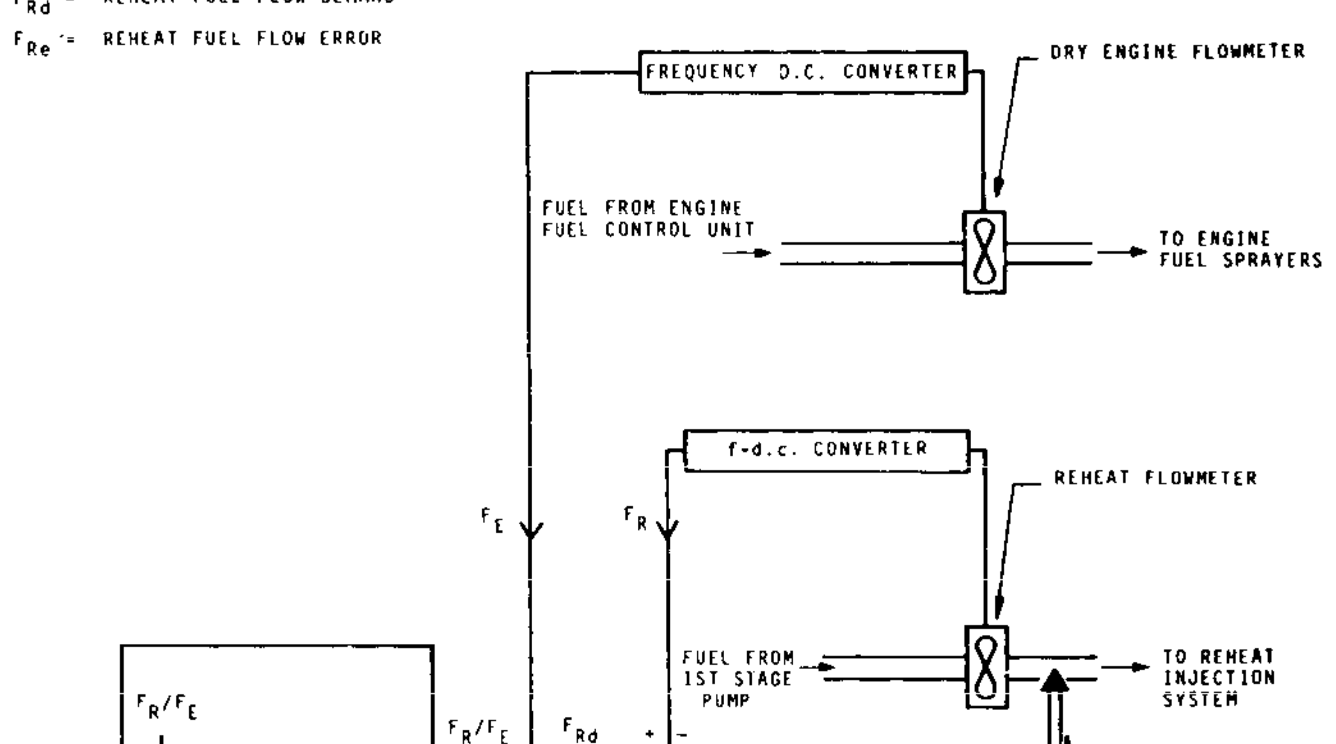
Reheat Control Amplifier - Schematic Diagram
Figure 022

F_E = ENGINE FUEL FLOW

F_R = REHEAT FUEL FLOW

F_{Rd} = REHEAT FUEL FLOW DEMAND

F_{Re} = REHEAT FUEL FLOW ERROR



Reheat System Basic Control Loop
Figure 023

(FR/FE scheduled as a function of T1) which replaces the take-off schedule and controls the reheat fuel flow to provide an increase in thrust.

Selection of contingency also increases the dry engine thrust, the overall effect being an increase in total thrust.

Selection of contingency rating is achieved by means of a three position reheat selector switch, switch 1 (Ref. Fig. 024), situated in the flight deck, the three selectable positions being OFF-REHEAT-CONTINGENCY.

Flight Schedule:

A flight schedule is used for transonic acceleration (Mach 0.9 to 1.7). Its purpose is to satisfy the rate of climb/fuel consumption requirements of the aircraft. The value of the flight FR/FE ratio also varies with T1.

TAKE-OFF/FLIGHT conditions will be selected by the two position change-over switch, switch 2 (Ref. Fig. 024) which is located on the flight deck.

Light-up Schedule:

To provide the optimum light-up conditions the reheat control system includes a light-up schedule (Ref. Fig. 024).

For light-up, reheat fuel flow FR is proportional to engine fuel flow FE but the FR/FE ratio is constant and therefore is not a function of T1.

Control of fuel flow for light-up, is automatically achieved by the operation of a two position electronic switch, switch 3 (Ref. Fig. 024). The position of this switch being determined by the logic circuit within the electronic control unit.

Fuel Flow Limitation:

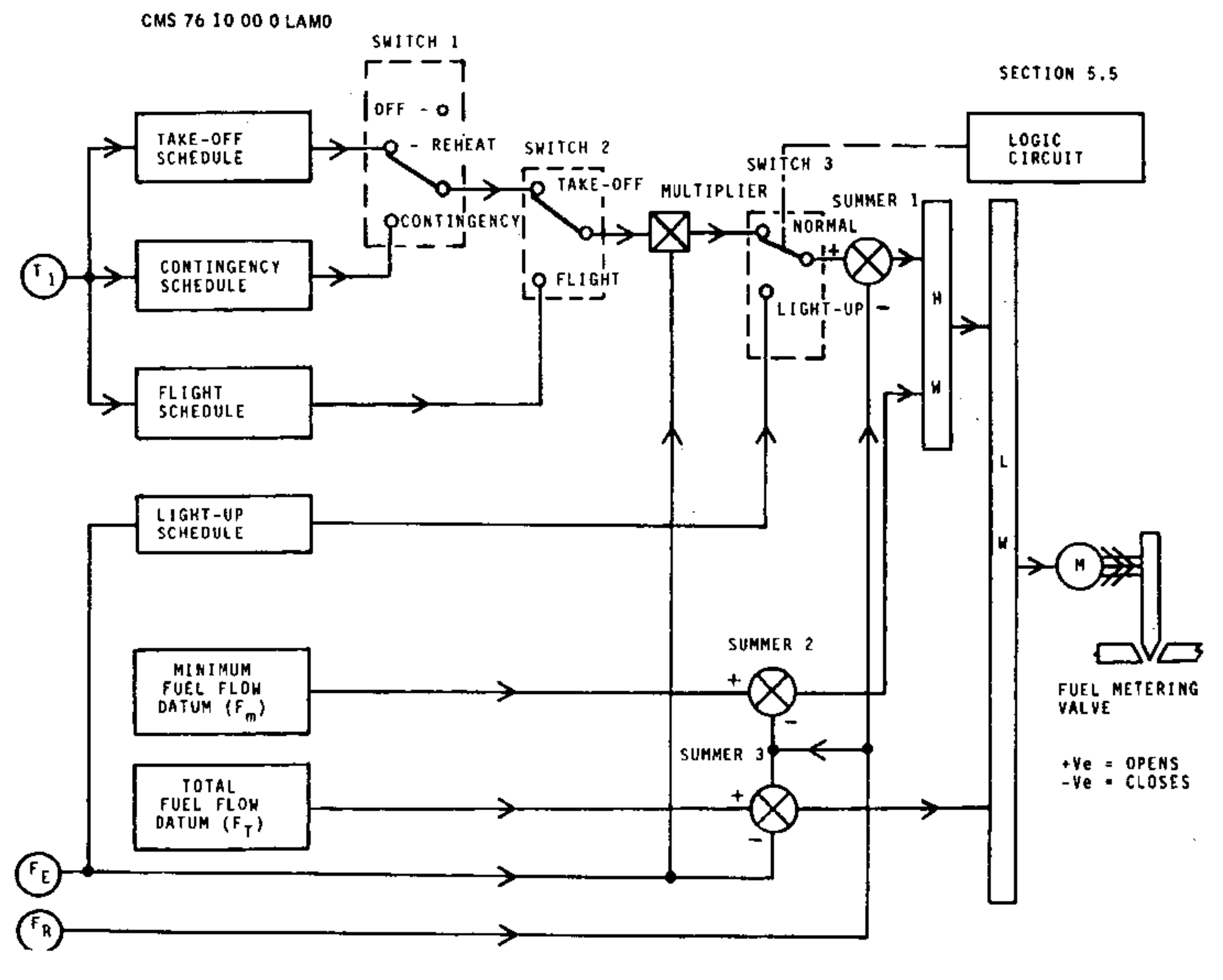
Two fuel flow limitations are included in the reheat system (Ref. Fig. 025). These are:

- A minimum fuel flow limitation to prevent weak extinction and formation of carbon in the reheat spray ring.
- A total fuel flow limitation in order not to exceed the flow capacity of the aircraft fuel system.

SWITCH 1
OFF
REHEAT
CONTINGENCY
TAKE-OFF SCHEDULE
CONTINGENCY SCHEDULE
FLIGHT SCHEDULE
T_1
TAKE-OFF
FLIGHT
MULTIPLIER
LOGIC CIRCUIT
NORMAL
LIGHT-UP
SWITCH 3
SUMMER 1
FUEL METERING VALVE
LIGHT-UP SCHEDULE
F_E
F_R

+ Ve = OPENS
— Ve = CLOSES

Reheat Control Schedule
Figure 024



Reheat Fuel Flow Limitations
Figure 025

Minimum Reheat Fuel Flow Limitation (Fm):

A fixed positive signal representing the minimum datum reheat fuel flow and an actual reheat fuel flow signal (increasing negatively with increasing fuel flow) are fed as inputs to a summer (2) (Ref. Fig. 025). The output from the summer (2) is taken as an input to a "highest wins" circuit, where it is compared to the control loop demand signal. Should the actual reheat fuel flow be greater than the minimum datum, the output from summer (2) is negative. At steady state conditions the signal will not affect reheat operation. During transient conditions this signal could limit the rate of reduction of fuel flow.

If the actual reheat fuel flow is equal to the minimum datum, the output signal from summer (2) is zero. This will prevent any closing signal being passed to the fuel metering valve motor.

Should the actual reheat fuel flow be less than the minimum datum, the output from summer (2) will be positive. This will provide an opening signal to the fuel metering valve motor until minimum datum fuel flow is restored.

Total Fuel Flow Limitation (FT):

The operation is identical to that of the previous limitation but a summer (3)(Ref. Fig. 025) is here supplied with two negative input signals i.e actual reheat fuel flow signal FR, and actual dry engine fuel flow signal FE. The sum FR plus FE is compared to a positive total fuel flow limitating datum (FT).

The output of summer (3) is taken as an input to the "lowest wins" network, where it is compared to the control loop demand signal. The action of the "lowest wins" network will ensure that the maximum total fuel flow is not exceeded by controlling the reheat fuel flow as required.

Logic Functions:

Within the reheat control amplifier are a number of logic circuits, their function being to provide automatic sequential operation of reheat. The overall reheat control falls into three main sequences which are the light-up sequence, the reheat operation sequence and the shut-down sequence.

Before reheat can be armed, three switches in series must be made (Ref. Fig. 026). These are:

- The engine shut-down handle switch, the purpose of which is to facilitate reheat shut-down when this handle is operated.

- The reheat selector switch, made when selected to REHEAT or CONTINGENCY.

- The 10% switch which is operated by the pilots' throttle lever, the function of which is to ensure reheat cancellation, prior to selection of reverse, during an accelerate-stop.

Should any of the switches be operated, so causing an open circuit whilst reheat is operating, the shut-down sequence is started. When the first two switches are made, an indicator light on the flight deck is illuminated.

Light-up and Schedule Control (Ref. Fig. 027):

Provided that the engine shut-down handle, the throttle lever (10%) reheat control switch and the reheat selector switch are made and that N1 is at or above 81%, the shut-off valve and the metering valve will open. The metering valve opens to a position determined by a light-up schedule using FR/FE as a reference. As the valves open time T2 starts. Time T2 is defined as the time during which the reheat light-up schedule is selected and the igniter is energized, its duration is 3.5 secs. The PM bolt network in the engine control unit is signalled to limit the opening angle of the Pm trim actuator to 10 deg greater than required by the E schedule in order to prevent N1 overswing on reheat shut-down. Simultaneously, the requisite E schedule is selected in the engine control unit. With REHEAT or CONTINGENCY selected in the TAKE-OFF mode, E low schedule is used for control. In the FLIGHT rating mode, with reheat selected E mid (E5/E2) is used. At the end of time T2, the fuel metering valve is released for control by the selected operating schedule and the igniter is de-energized.

Reheat operation is detected by the reheat detection pressure switch installed in the nacelle and the reheat flame detector mounted on the spherical joint flange, both signalling the configuration warning light (CON).

Primary indication of reheat ignition is taken from the configuration warning light. An increase in nozzle area, shown on a nozzle area indicator on the flight deck, also occurs when reheat light-up takes place. In flight, the increase in nozzle area might not be sufficient to determine if reheat is operating or not and the con-

REHEAT
SELECTED
LIGHT

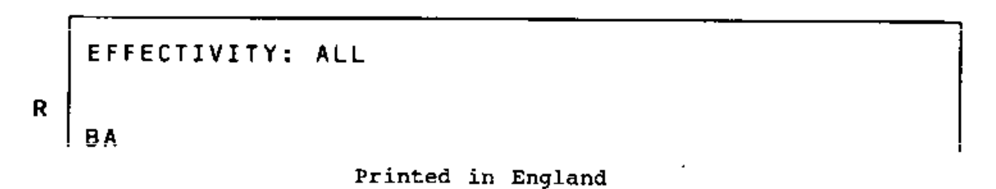
ENGINE
SHUT-DOWN
HANDLE
NORMAL

REHEAT
SELECTOR
SWITCH
ON

PILOTS
THROTTLE
LEVER
ANGLE
GREATER THAN 10%

SHUT-DOWN SEQUENCE

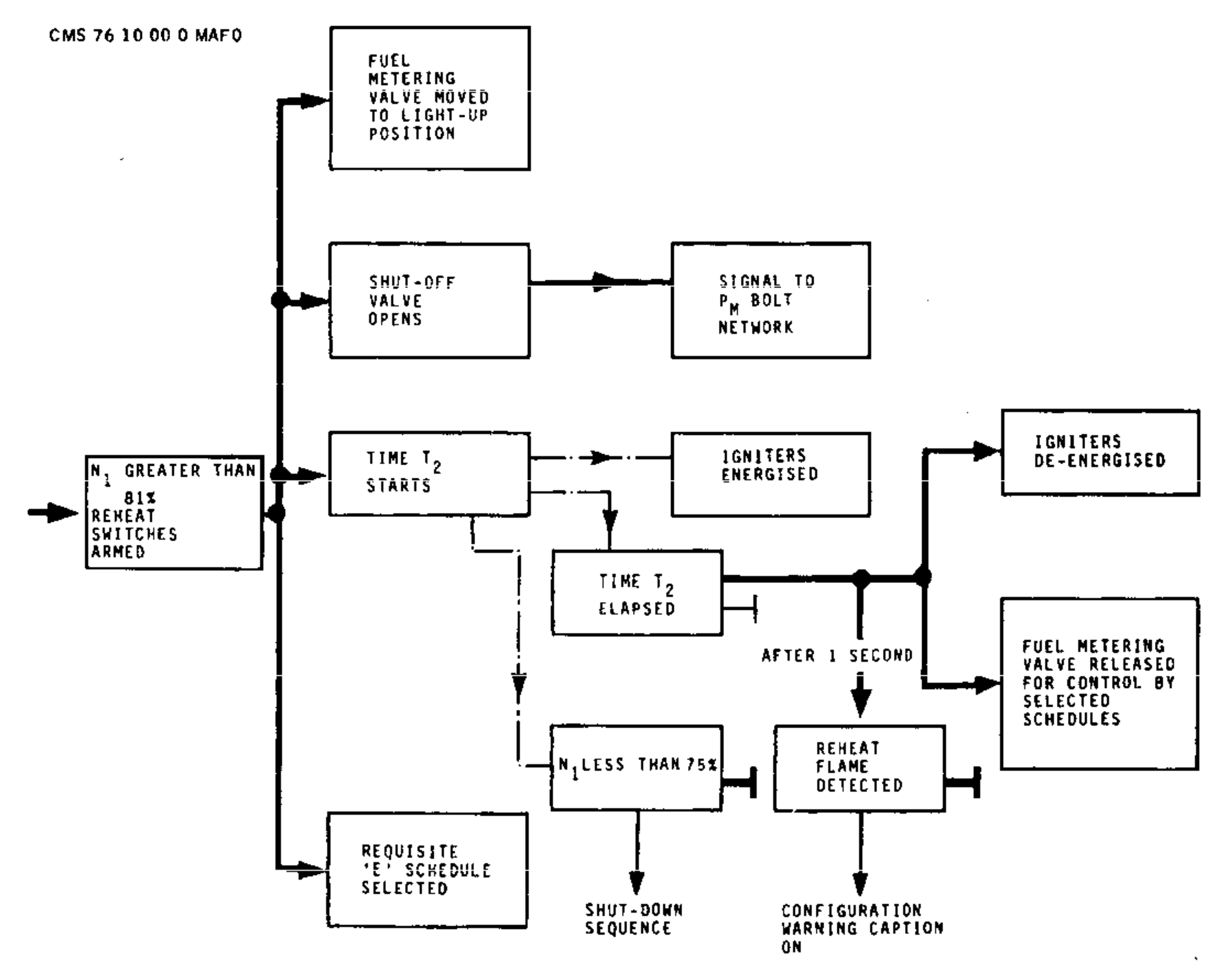
Reheat Arming Switches
Figure 026


EFFECTIVITY: ALL

R

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CMS 76 10 00 0 MAFO



Light-up and Schedule Control Sequence
Figure 027

figuration warning light is used for this purpose. If reheat flame is detected before the end of time T2 plus one second, i.e. if reheat operation is satisfactory the configuration light does not illuminate. Illumination of the configuration light indicates either a fault in the detection system or the absence of a reheat flame.

After start of time T2, should N1 fall below 75%, automatic shut-down would take place.

Shut-down Sequence (Ref. Fig. 028):

Reheat shut-down sequence may be initiated by: switching off reheat, some of the logic sequences previously described, failure of selected circuits or failure of the alternating current supply.

Immediately the order to shut-down is given:

- A closing signal is supplied to the fuel metering valve.

- If during the light-up sequence, the igniter is de-energized.

- The PM bolt schedule is lowered by 20 deg during 0.5 second, thus providing a closing signal to the Pm trim unit and decreasing the risk of N1 overspeed at the extinction of the reheat flame.

- The requisite E schedule is selected.

- Time T3 starts (T3 is the time within which the fuel metering valve should close (15 seconds)).

After five seconds time T4 starts. T4 is the time during which the purge valve solenoid is energized, its duration being five seconds. Two seconds after the end of T4 and before the end of T3, should reheat flame still be detected, the reheat failure warning caption is illuminated and latched. At the end of time T3, the closing signal to the fuel metering valve is cancelled. If the purge valve is not fully shut at the end of time T3, the reheat failure warning light labelled REHEAT will illuminate.

Other time delays (T5,T6,T7) prevent overlapping of the sequences previously described.

Should reheat relight be required before the termination of time T3 the reheat selector must be switched to OFF and then ON. This action will cause sequence T3 to stop

CLOSING SIGNAL TO FUEL METERING VALVE

P_M BOLT SCHEDULE LOWERED BY 20° DURING 0.5 s AND DRY ENGINE REQUISITE 'E' SCHEDULE SELECTED

TIME T_3 STARTS

TIME T_3 ELAPSED

CLOSING SIGNAL TO FUEL METERING VALVE CANCELLED

POWER SUPPLY TO IGNITER (IF STILL ENERGISED) AND TO SHUT-OFF VALVE CUT

AFTER 5 SECS.

TIME T_4 STARTS

TIME T_4 ELAPSED

AFTER 2 SECS.(T_6)

REHEAT FLAME DETECTED

PURGE VALVE SOLENOID ENERGISED

PURGE VALVE SOLENOID DE-ENERGISED

PURGE VALVE SHUT

REHEAT FAILURE WARNING CAPTION

Reheat Shut-down Sequence
Figure 028



immediately and sequence T2 will commence provided N1 is more than 81%.

Loss of engine entry temperature T1 does not cancel reheat operation but only reduces the FR/FE fuel ratio to a fixed value.

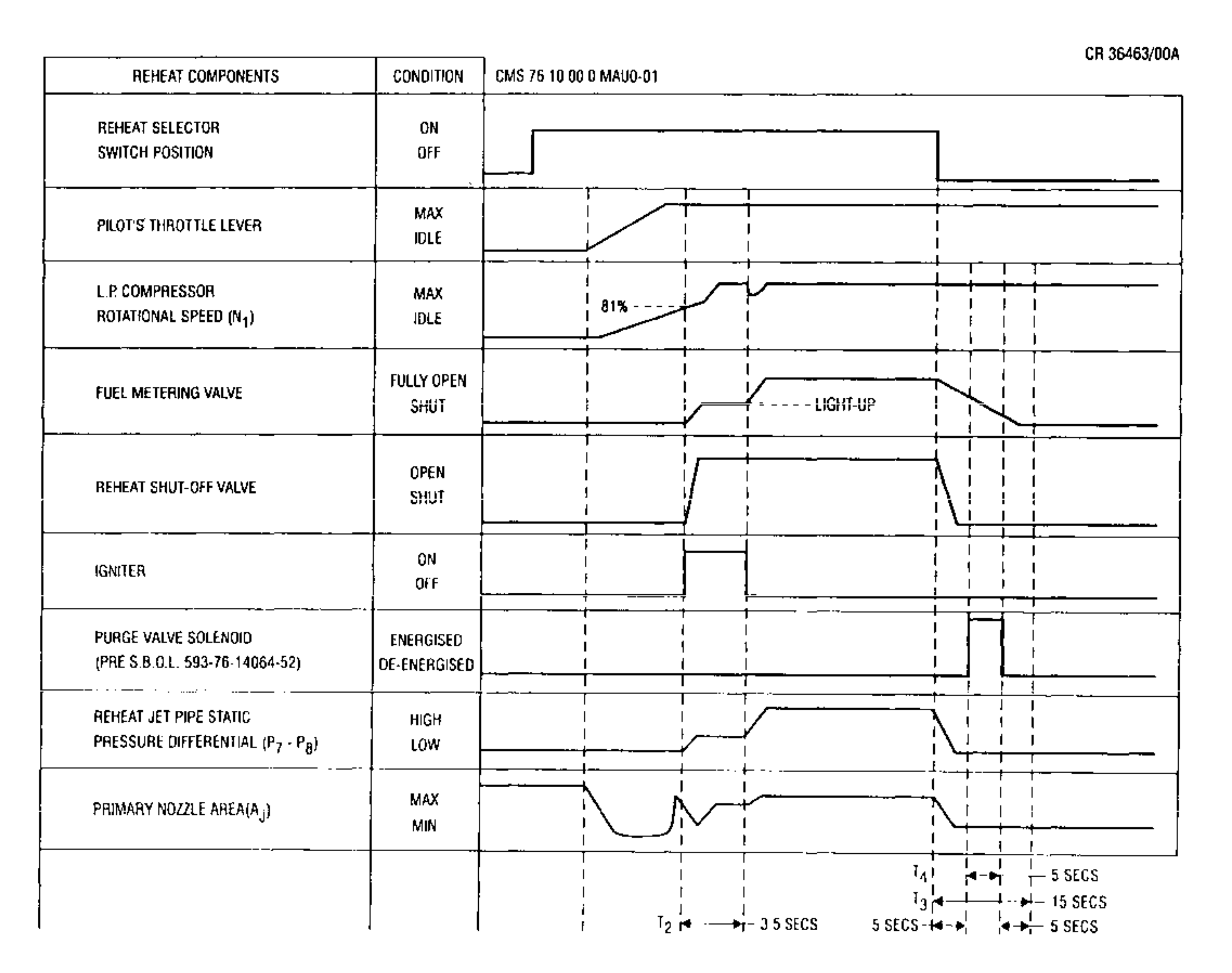
Sequential Operation of Reheat (Ref. Fig. 029):

The reheat system may be selected ON at any time but its operation is dependent upon dry engine conditions.

The illustration (Ref. Fig. 028) shows the main reheat components, their condition and operation with respect to time. The initial conditions are that the engine is running at idle with reheat selected OFF.

Reheat is selected ON. This has no effect on the reheat system. The pilot's throttle lever is pushed forward resulting in an engine acceleration with consequent increase in N1 and variation in the nozzle area, as imposed by the E schedule described previously. When 81% N1 is achieved the light-up sequence commences and time T2 starts. At the commencement of T2, the fuel metering valve is driven to the scheduled light-up position, the shut-off valve opens, the safety relay and the relay are energized and the ignitor operates; light-up may occur at any point during time T2. Simultaneously, the nozzle control system senses a rise in reheat jet pipe total pressure (P7) due to the reheat light-up and causes the nozzle to open thus maintaining a constant P7/P3 ratio. Also the pressure differential across the reheat jet pipe is increased. When T2 time has elapsed the ignition relay is de-energized and the fuel metering valve is released for control by the selected reheat operating schedule.

Directly after light-up has taken place and also when reheat fuel flow is increased, N1 drops slightly due to the rise in P7. The opening of the primary nozzle restores N1 and P7 to their original value. Upon selection of reheat OFF, time T3 commences. The shut-off valve closes and the fuel metering valve is driven towards its shut position. The reheat flame is extinguished, resulting in a reduction of the jet pipe differential pressure and of primary nozzle area. Five seconds after beginning of T3, time T4 starts.
R At the end of time T4 (on pre SB OL93-76-14064-52 standard
R engines), the purge valve solenoid is de-energized. Before the end of time T3 the fuel metering valve should be fully closed. Should the engine be accelerated to maximum power before reheat is selected ON, the operating sequence is the same as that previously described, but will commence as soon



Sequential Operation of Reheat
Figure 029

EFFECTIVITY: ALL

as the reheat selector switch is operated.

Power Management Lights (Ref. Fig. 030)

The power management lights are situated on panel 6-211 and include a green, clear to go, light and an amber configuration caption light labelled CON. This light will illuminate when:

- Forward thrust is selected
- Throttle lever is greater than 10%
- N1 is greater than 81%
- Reheat is selected ON and light-up is not being detected.

Four lights captioned REHEAT, are locared on the upper power management panel 1-214. Should failure of the reheat control amplifier occur, the light will illuminate.

"CLEAR TO GO" LIGHT

TAKE-OFF MONITOR SWITCH MADE

AIRCRAFT WEIGHT SWITCH MADE

TOTAL FUEL FLOW AND P_7 GREATER THAN DATUM

BUCKETS AT CORRECT ANGLE

CONFIGURATION LIGHT OUT

REHEAT SELECTED ON AND NOT DETECTED

CON

FORWARD THRUST SELECTED

PILOTS THROTTLE LEVER 10%

N_1 GREATER THAN 81%

REVERSE THRUST BUCKET POSITION INDICATOR

REV

Power Management Lights
Figure 030

1. Auto Contingency Operational Test

This topic comprises a complete operational test of the auto contingency selection circuits.

R The tests covered in Para.2 A-G are particular to this topic and are not duplicated elsewhere in the manual.

R In the case of Paras. 2H-K and 3, alternative ground running tests are provided in 71-00-00, Adjustment/Test.

Where the specified test sets are available, their use is preferred, but procedures without test sets are given where applicable. For the purpose of these tests, the differences between Ultra Test Sets QT6A15/24 and 24A are not significant, either can be used.

2. Relay Reheat Selected, Relay Auto Contingency, Relay Speed
R Slave, Flasher CTY Caption, Diodes and Wiring

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Reheat test set or Multimeter	997-531-034 -
R Test Set QT6A15/24 or 24A	-

B. Prepare for Test using Reheat Test Set

(1) Set the EMERG GEN switch to ISOL.

(2) Make available electrical ground power (Ref. 24-41-00, Servicing).

(3) Position the throttle levers fully rearward in the gate, with the thrust reverse levers fully down.

(4) Check that the relevant circuit breakers are set:

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
	Engine No.1			
	RATING IND SUP	3-213	K2300	G 5
	RATING CONT	3-213	1K8	C 3
	REHEAT CONT	15-216	1K1542	E 9
	REHEAT AMP SUP	14-215	1K1541	C12
	2 & 3 EMER REL'T BUS			
R	SELECT SUP	1-213	1X230	R10
	Engine No.2			
	RATING IND SUP	3-213	K2300	G 5
	RATING CONT	1-213	2K8	E 8
	REHEAT CONT	15-215	2K1542	D15
	REHEAT AMP SUP	13-215	2K1541	B14
	2 & 3 EMER REL'T BUS			
	SELECT SUP	1-213	1X230	R10
	Engine No.3			
	RATING IND SUP	3-213	K2300	G 5
	RATING CONT	1-213	3K8	E 2
	REHEAT CONT	15-215	3K1542	D16
	REHEAT AMP SUP	13-216	3K1541	B 7
	2 & 3 EMER REL'T BUS			
	SELECT SUP	1-213	1X230	R10
	Engine No.4			
	RATING IND SUP	3-213	K2300	G 5
	RATING CONT	3-213	4K8	C 4
	REHEAT CONT	15-216	4K1542	E10
	REHEAT AMP SUP	14-216	4K1541	D 7
	2 & 3 EMER REL'T BUS			
R	SELECT SUP	1-213	1X230	R10

(5) Trip LH U/C WEIGHT SW 'B' SYS SUP circuit breaker G293 on panel 3-213, map ref. B8.

(6) Prepare the test set:

(a) Place the mode selector on MAN.

(b) Select TEST SET switch OFF.

(c) Select Tt1, Fc, Fr, NL switches OFF.

(7) Connect the reheat test set to the reheat control

amplifier.

ENGINE No	RACK	AMPLIFIER
No 1	3-243	1K1553 REHEAT No 1
No 2	4-243	2K1553 REHEAT No 2
No 3	4-244	3K1553 REHEAT No 3
No 4	6-244	4K1553 REHEAT No 4

(8) Press the TEST IND LIGHTS push button and check that all the indicating lights illuminate.

C. Test using Reheat Test Set

(1) Select the TEST SET switch ON and check that the 28V and 115V indicators illuminate.

NOTE: The PURGE CLOSED indicator will also illuminate but is not relevant to the tests.

(2) At the centre console, set the appropriate RHT/CTY switch to RHT.

(3) Press the T/O MONITOR arming switch and check that it latches in and that the CTY caption flashes.

(4) On the test set, check that the CONTINGENCY light illuminates.

(5) Select the TEST SET switch to OFF and disconnect the test set.

(6) Repeat operations (1) to (5) on the remaining engines.

D. Conclusion

(1) Set the reheat selector switches to OFF and check that the T/O MONITOR switch trips out.

(2) Refit the amplifier socket cover and the rack enclosure panels.

(3) Reset the U/C weight switch circuit breaker previously tripped.

(4) Reset the EMERG GEN switch to NORM.

E. Prepare for Test using Multimeter when Reheat Test Set is not available

(1) Set the EMERG GEN switch to ISOL.

(2) Check that the circuit breakers in para. B.(4) are set, and that the circuit breaker at B.(5) is tripped.

(3) Make available electrical ground power, (Ref. 24-41-00, Servicing).

F. Test using Multimeter when Reheat Test Set is not available

(1) At the centre console, set all four RHT/CTY switches to RHT.

(2) Above the centre dash panel 6-211, press the T/O MONITOR arming switch and check that the CTY caption (yellow), on the engine rating indicator, flashes.

(3) Remove the cover from the appropriate rack Ref. para.B.(7). Locate pin Z on the REHEAT amplifier test socket and check for 28V d.c.

(4) Set the reheat selection switches to OFF and check that the T/O MONITOR button trips out.

G. Conclusion

(1) Refit the amplifier socket covers as necessary.

(2) Refit the cover panels.

(3) Reset the U/C weight switch circuit breaker previously tripped.

(4) Reset the EMERG GEN switch to NORM.

(5) Remove electrical ground power, (Ref. 24-41-00, Servicing).

H. Prepare for Test using Test Set QT6A15/24 or 24A

NOTE: All 8 ECU's must be tested.

(1) Trip the following circuit breakers applicable to the engine under test, and fit safety clips:

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1 MAIN THROT SUP	2-213	1K1	F12
ENG 1 ALTN THROT SUP	14-215	1K2	G12
ENG 1 REHEAT CONT	15-216	1K1542	E 9
ENG 2 MAIN THROT SUP	2-213	2K1	C12
ENG 2 ALTN THROT SUP	13-215	2K2	F14
ENG 2 REHEAT CONT	15-215	2K1542	D15
ENG 3 MAIN THROT SUP	2-213	3K1	C13
ENG 3 ALTN THROT SUP	13-216	3K2	A 7
ENG 3 REHEAT CONT	15-215	3K1542	D16
ENG 4 MAIN THROT SUP	2-213	4K1	F13
ENG 4 ALTN THROT SUP	14-216	4K2	C 7
ENG 4 REHEAT CONT	15-216	4K1542	E10

(2) Check, on the roof panel, that the THROTTLE MASTER switch is set to OFF.

(3) Remove the relevant plug and socket covers on the amplifier and connect the test set cable 2 to test set PL2 and amplifier socket SK2.

(4) Check that the following circuit breakers are set or reset for the engine under test:

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No. 1			
MAIN THROT SUP	2-213	1K1	F12
MAIN THROT CONT	3-213	1K3	A 1
ALTN THROT SUP	14-215	1K2	G12
ALTN THROT CONT	15-216	1K4	E 8

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
MAIN THROT FAIL IND	1-213	1K5	A 1
ALTERN THROT FAIL			
IND AND AJ MAX SUP	3-213	1K6	B 1
RATING CONT	3-213	1K8	C 3
N2 RPM IND	2-213	1E241	G10
ENG INST BUS 6XS	2-213	X352	H 3
<u>Engine No. 2</u>			
MAIN THROT SUP	2-213	2K1	C12
MAIN THROT CONT	1-213	2K3	A 3
ALTN THROT SUP	13-215	2K2	F14
ALTN THROT CONT	15-215	2K4	F15
MAIN THROT FAIL IND	3-213	2K5	A 3
ALTN THROT FAIL IND			
AND AJ MAX SUP	1-213	2K6	B 3
RATING CONT	1-213	2K8	E 8
N2 RPM IND	2-213	2E241	D12
ENG INST BUS 5XS	2-213	X351	H 4
<u>Engine No. 3</u>			
MAIN THROT SUP	2-213	3K1	C13
MAIN THROT CONT	1-213	3K3	A 4
ALTN THROT SUP	13-216	3K2	A 7
ALTN THROT CONT	15-215	3K4	F16
MAIN THROT FAIL IND	3-213	3K5	A 4
ALTN THROT FAIL IND			
AND AJ MAX SUP	1-213	3K6	B 4
RATING CONT	1-213	3K8	E 2
N2 RPM IND	2-213	3E241	D18
ENG INST BUS 5XS	2-213	X351	H 4
<u>Engine No. 4</u>			
MAIN THROT SUP	2-213	4K1	F13
MAIN THROT CONT	3-213	4K3	A 2
ALTN THROT SUP	14-216	4K2	C 7
ALTN THROT CONT	15-216	4K4	F11
MAIN THROT FAIL IND	1-213	4K5	A 2
ALTN THROT FAIL IND			
AND AJ MAX SUP	3-213	4K6	B 2
RATING CONT	3-213	4K8	C 4
N2 RPM IND	2-213	4E241	G11
ENG INST BUS 6XS	2-213	X352	H 3

J. Test using Test Set QT6A15/24 or 24A

(1) Make the following flight compartment switch selections:

Reheat switch	OFF
ENG RATING MODE	TAKE-OFF
ENGINE CONTROL SCHEDULE	LO
Pilots throttle lever	idle
THROTTLE MASTER	MAIN or ALTERN
ENG 4 T/O N1 LIMITER	NORM

(2) Make the following test set switch selections:

SW1	position 1
SW2	position 2
SW3	SIM
RT	up
EN	up
YAW	up
U/C	up
RBD	up
TJO/C	up

(3) Move the throttle lever forward to obtain an N2 value of approximately 99% on the dash panel indicators, and allow the indicators to stabilize. Note the value obtained.

NOTE: If N2 fails to increase when the throttle lever is advanced select the THROTTLE MASTER switch OFF and back to MAIN or ALT as required.

(4) Set the reheat selector switch to CTY and note the N2 stabilized indication. There must be a discernable increase of up to 1.9% above the value noted in para.C.(3).

K. Conclusion

(1) Reset the flight compartment switches to their ori-final position, Ref. para.C.(1), and the throttle levers to idle.

(2) Trip the THROT SUP circuit breaker to isolate the test set and disconnect and remove the test set.

(3) Refit the amplifier socket covers as necessary.

(4) Reset the REHEAT CONT and THROT SUP circuit

R breakers previously tripped.

R (5) Check that the area is clean and refit the rack en-
R closure panels.

R 3. Engine Speed Unit Auto Contingency Signal
R and Diode E581 Continuity Check

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit Breaker Safety Clips	-
Test Set(s) QT6A15/24, 24A	-
R Sine Wave Generator(s) of 12-15V R.M.S.	-
N1 and N2 signal adapter(s)	TE6026000

B. Prepare

(1) Set the throttle levers rearward to idle, with the thrust reverse levers fully down.

(2) On the roof panel set the THROTTLE MASTER switches at OFF.

(3) Open the following circuit breakers:

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1 MAIN THROT SUP	2-213	1K1	F12
ENG 1 ALTN THROT SUP	14-215	1K2	G12
ENG 2 MAIN THROT SUP	2-213	2K1	C12
ENG 2 ALTN THROT SUP	13-215	2K2	F14
ENG 3 MAIN THROT SUP	2-213	3K1	C13
ENG 3 ALTN THROT SUP	13-216	3K2	A 7

Printed in England

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 4 MAIN THROT SUP	2-213	4K1	F13
ENG 4 ALTN THROT SUP	14-216	4K2	C 7

(4) Obtain access to the following amplifiers:

ENGINE CONTROL AMPLIFIER	EQUIP IDENT	SHELF
No.1 Alternate	1K21	6-215
No.2 Main	2K20	6-215
No.3 Alternate	3K21	6-216
No.4 Main	4K20	6-216

(5) Connect a sine wave frequency source to each of the above amplifiers using:

R (a) Test Sets QT6A15/24 or 24A, connecting test set cable 2 between test set PL2 and amplifier SK2, connecting.

(b) Sine wave generators capable of producing 12-15V R.M.S., 3k Hz, connecting them to amplifier SK1 using the N1 and N2 adapter(s) TE6026, (Ref. 77-11-00, Adjustment/Test).

CAUTION: IF INPUTS ARE CONNECTED DIRECT TO TEST SOCKET SK1, CARE MUST BE TAKEN TO SELECT ONLY THE CORRECT PINS 44(HI) AND 45(LO).

(c) A combination of (a) and (b).

(6) Adjust the frequency of the sine wave generators to approximately 2600 Hz, and the amplitude to the level required to drive the associated N2 indicator.

CAUTION: DO NOT EXCEED 15V R.M.S.

(7) Where the test sets are connected, close the associated THROT SUP circuit breakers.

(8) Check that all four N2 indicators read greater than 60%.

C. Test

(1) Press the T/O MONITOR arming switch and check that it remains latched in.

R (2) Select EMERG GEN switch to ISOL.

R (3) Select Engine No.1 reheat selector switch to RHT.

R (4) Trip LH U/C WEIGHT SW 'B' SYS SUP circuit breaker
R G293 and check that the T/O MONITOR arming switch
R remains latched in.

R (5) On the pilots centre dash panel, check that the CTY caption remains extinguished.

R (6) Isolate each frequency input in turn and check that the CTY caption flashes when the input is isolated,
R and extinguishes when the input is reinstated.

NOTE: Where test sets are connected, the frequency input is isolated by tripping the associated THROT SUP circuit breaker.

D. Conclusion

R (1) Select the reheat switch to OFF and check that the T/O MONITOR arming switch trips out.

(2) Trip the THROT SUP circuit breakers to isolate the test set: remove the test sets.

(3) Refit the engine control flight plugs/socket covers, as necessary.

(4) Reset the circuit breakers previously tripped.

R (5) Reset the EMERG GEN switch to NORM.

R (6) Switch off and disconnect electrical ground
R power (Ref.24-41-00).

(6) Disconnect electrical ground power, (Ref. 24-41-00, Servicing).

END OF THIS SECTION

NEXT

ENGINE POWER CONTROL - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

Engine Power control comprises the Adjustment/Test on:

(a) The mechanical input to the throttle transmitters in the centre console paragraphs 2, 3, 4, 5, 6 and 14.

(b) The electronic control system paragraphs 7, 8, 9, 10, 11, 12 and 13.

Each throttle consists of a forward thrust lever with a reverse thrust lever pivoted at its forward edge. For details of the setting and tests on the reverse thrust lever refer to 78-30-00.

The following adjustments on Throttle linkage, the Idle and Maximum stops, and the Operational and Mechanical input tests are written for one throttle channel only but apply to all four channels. Other tests and adjustments will be found in the sub-chapters to this chapter.

Separate procedures for carrying out tests on the engine control system are detailed in this chapter. One procedure for fault locating only using test set PE.35480 is given in paragraph 7., further procedures for complete system tests, including fault interrogation using an Ultra test set are given in paragraphs 8 to 11.

R Control system

R Check for any history of defects.

R Check engine control amplififer for any F.I.M. codes
R displayed.

R Interchanging engine control amplifiers is permissible
R for non-reproduceable defects.

R Carry out relevant Maintenance Manual checks in accordance
R with Chart 501.

R For any parameter problem/investigation the Ultra test set
R QTY 6A15/24A or 24B must be used.

There are two approved types of Ultra test sets, QT 6A15/24A and 24B, and three types of amplifier, A6A16/24CA, 24CC and

24DC. Establish the type of test set and the type of amplifier before commencing the test procedure.

Adjustment/Test procedures using the Ultra test sets are given in the following sequence:

Test Set Confidence Check (Ref.para.9) - checks for correct functioning of the test set should control system check results appear inncorrect.

Control System Check (Ref.para.10) - gives two checking procedures, one applicable when a malfunction has occured without activation of the throttle failure warning and a second, fault interrogation procedure, which is applicable following a throttle failure warning. A further function lamp check is given to ascertain whether a fault is within an amplifier or external to it in the switches or wiring.

Component Post-installation Checks (Ref.para.11) - details applicable procedures.

Datum Adjustment Procedures (Ref.para.12).

Fault Identification Module (FIM) Procedures (Ref.para.13).

A safety system checkout is required periodically to prove normally dormant circuitry.

Pilots throttle control transmitter setting tests are carried out, as required, to confirm the adjustment of the mechanical linkages in the pilots console.

The applicability of the tests in respect of separate components will be given later.

2. Throttle Linkage Adjustment

A. Equipment and Materials

DESCRIPTION	PART NO.
Optical measuring tool	QV6A01
Gauge, position	QG6A01
Torque spanner range : 0-80 lbf in (0-0.90 mdaN)	-

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Corrosion resistant steel locking wire 0.031 in (0.8 mm) dia	DTD189
Test set	QT6A15/24
Screwdriver (Torque set)	

B. Preparation (Ref. Fig.501 and 502)

(1) Trip the appropriate circuit breakers and secure them with safety clips.

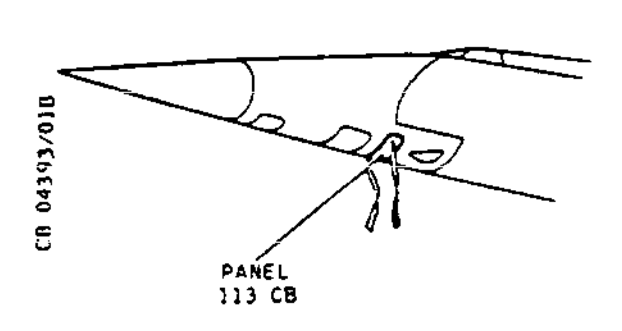
(2) Remove the centre console aft left-hand side panel:

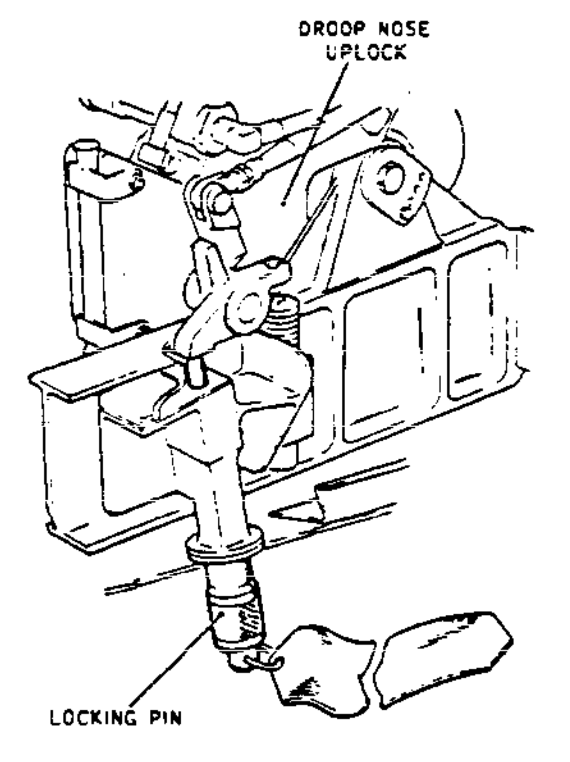
(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilots' floor illumination at the receptacle identified U2026 on the panel.

(c) Remove the panel.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALT THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
PP MGT LTS SUP	5-213	1E461	D 1
ENG 2			
MAIN THROT CONT.	1-213	2K3	A 3
ALT THROT CONT.	15-215	2K4	F15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
PP MGT LTS SUP	1-213	2K461	E 3
ENG 3			
MAIN THROT CONT.	1-213	3K3	A 4
ALT THROT CONT.	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6
REHEAT CONT	15-215	3K1542	D16
PP MGT LTS SUP	1-213	3K461	E 4
ENG 4			
MAIN THROT CONT.	1-213	4K3	A 2
ALT THROT CONT.	15-215	4K4	F11
REV THRUST CONT	1-213	4K331	B 2
REHEAT CONT	15-215	4K1542	D10
PP MGT LTS SUP	1-213	4K461	E 2
AT SYS 1 SUP	13-215	1C179	C 6
AT SYNCHRO SYS 1 SUP	13-215	1C181	D 5
AT 1 CONT	1-213	1C180	Q12
AFCS 1 CONT	1-213	1C19	Q14
AT SYS 2 SUP	13-216	2C179	D16
AT SYNCHRO SYS 2 SUP	13-216	2C181	B17
AT 2 CONT	5-213	2C180	A14
AFCS 2 CONT	5-213	2C19	A12
CHART STOWAGE LTS SUP	15-216	L237	D12
R NOSE 5 deg. CONT	1-213	M12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17





CB 04393/01B

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Droop Nose Locking Pins
Figure 501

LEFT BLANK INTENTIONALLY

(3) Remove the droop nose emergency lever (Ref. Fig. 501):

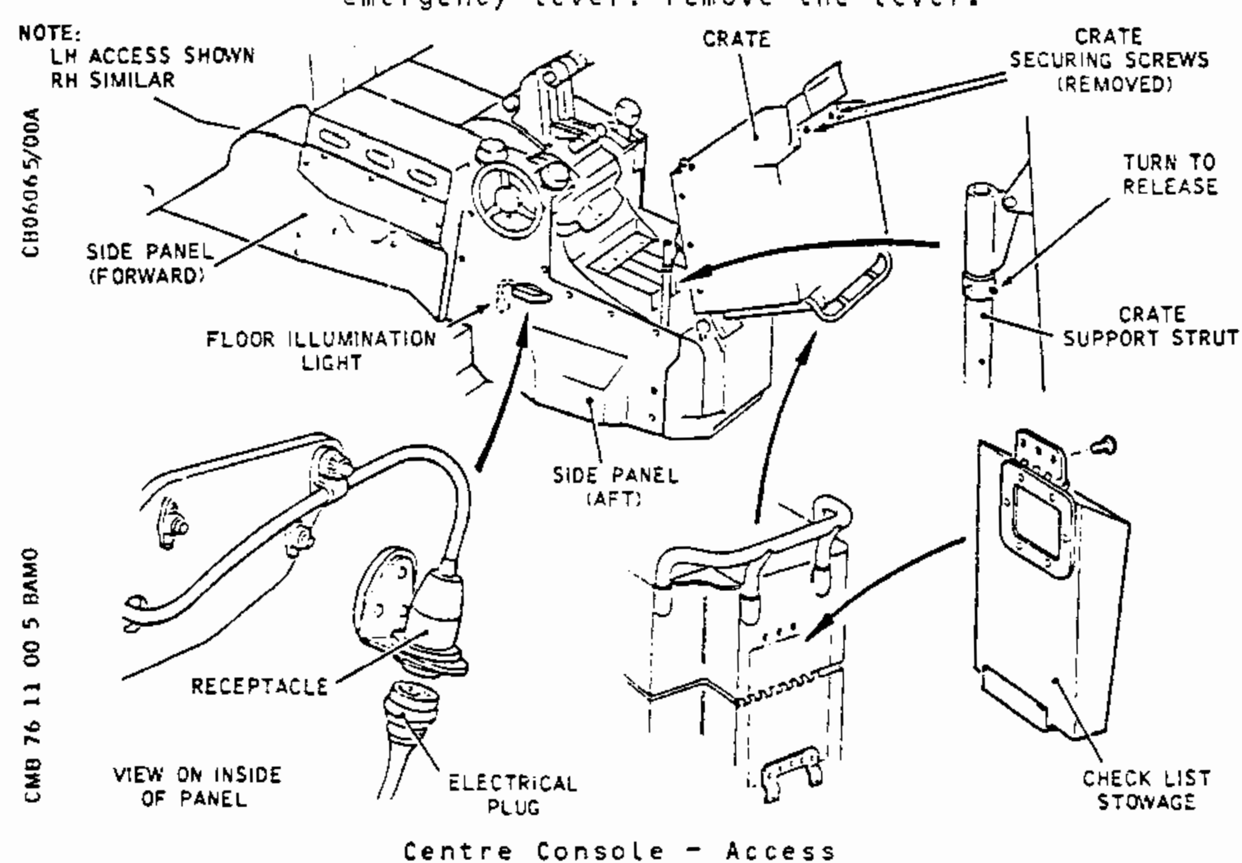
NOTE: This can be done with the nose either up or down.

(a) If the nose is up fit pins (2) in the droop nose uplocks.

NOTE: No pin is required if the nose is down.

(b) Using the ring pull the release pin outwards at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the left-hand side and depress the spring-loaded pin on the forward end of the droop nose emergency lever: remove the lever.



Centre Console - Access
Figure 502

(4) Remove the centre console aft right-hand side panel in a manner similar to that described for

the left-hand; the electrical plug identification is U2025.

(5) Remove the centre console forward side panels.

(6) Remove the screws securing the check list stowage; remove the stowage.

(7) Remove the screws securing the crate; hinge back the crate.

(8) Unscrew the knurled nuts and extract the No. 1 and No. 2 throttle transmitters

NOTE: To fit the optical measuring tool into a given throttle channel it is necessary to remove also the adjoining transmitters.

C. Adjustment (Ref. Fig.503 and 504)

(1) Unlock the No. 1 throttle rod linkage:

(a) Remove the locking wire from the top and bottom of the rod linkage.

(b) Slacken both locknuts and the quick-release nut.

(2) Turn the rod clockwise or counter clockwise to adjust the rod length.

(3) Check the optical measuring tool:

(a) Remove the optical measuring tool from its case.

(b) Depress the pushbutton and check that the panel light illuminates.

(c) Fit the position gauge over the tool coupling shaft and verify that the vernier scale indicates 36 degrees; raise the dust cover to see the reading.

(d) If necessary, calibrate the tool:

(1a) Remove the screws and the cover from the vernier scale, and slacken the two Allen screws below the cover.

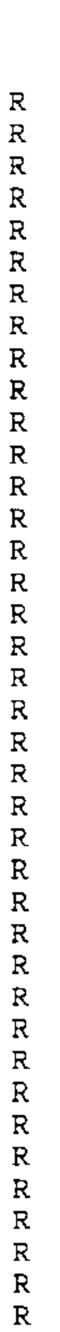
(1b) Set the scale to 36 degrees precisely

ACTIONS IN EVENT OF CONTROL SYSTEMS DEFECT

CR 36439/00B

DEFECT	FAULT DIAGNOSIS
LOW POWER OR RUN RUN DOWN / TAKE OFF NOISE ABATE	71-00-57 CHART 102
RAPID DECEL.	71-00-26 CHART 110
BOTH ECA	71-00-57 CHARTS 103
ONE ECA	71-00-57 CHART 105
IDLE OR REVERSE	71-00-57 CHART 101
INTERMITTENT POWER LOSS	WIRING CHECKS TO THROTTLE ACTUATOR-PNT EGT SYSTEM 77-21-02 AND 03 N1 O/S GOVERNOR 71-00-46 CHART 103 N1/N2 RPM PROBE 76-12-01 AND 02 LP SHAFT SIGNAL SYSTEM 76-21-00 HP GOVERNOR (FCU) 71-00-00

Chart 501 (Sheet 1 of 2)



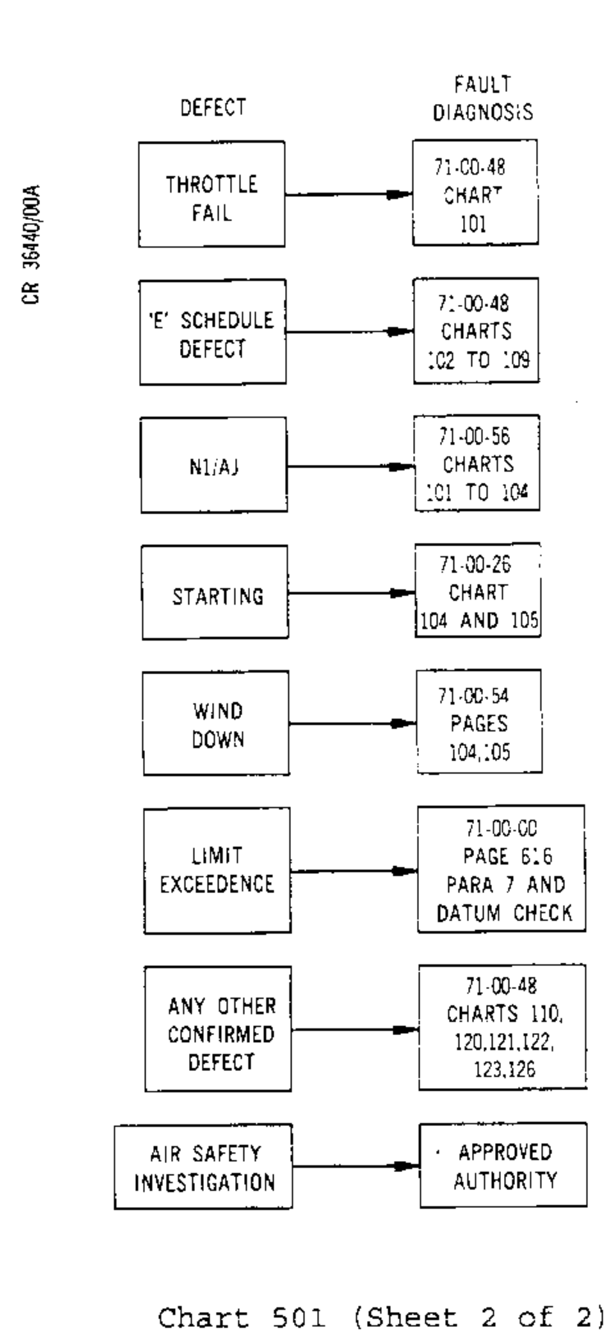
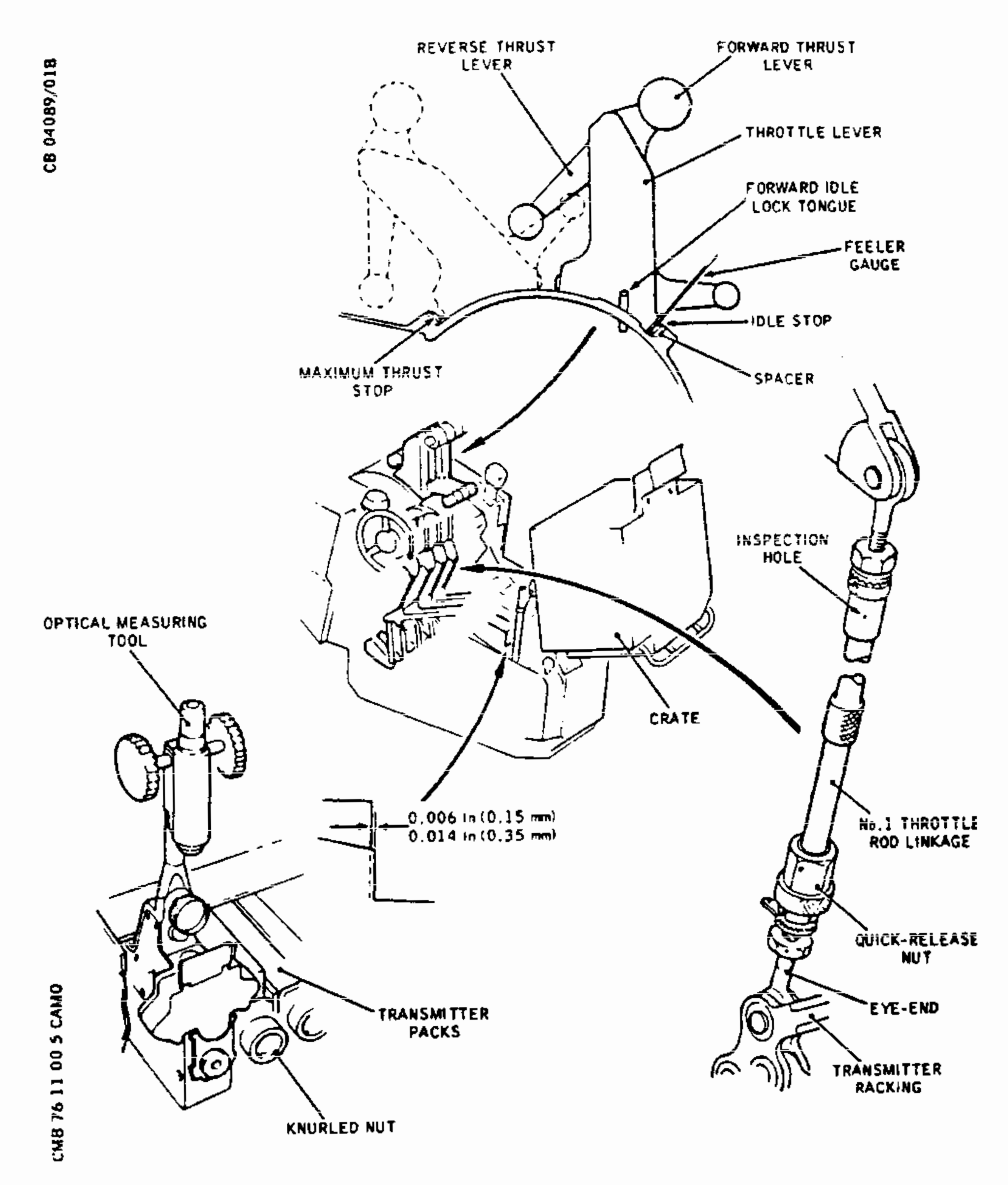


Chart 501 (Sheet 2 of 2)



Power Control Settings
Figure 503

CB 07494/00A

POSITION GAUGE

FOCUS ADJUSTMENT

PUSH BUTTON

OPTICAL ATTACHMENT

PUSH BUTTON

TOOL COUPLING SHAFT

BATTERY COMPARTMENT (ALKALINE)

DUST COVER

PANEL LIGHT

ADJUSTING SCREW

VERNIER SCALE

A

ADJUSTING SCREW

COVER SCREW

LOCKING SCREWS

VIEW ON ARROW A (WITH COVER REMOVED)

CMB 76 11 00 5 0AMO

Optical Measuring Tool
Figure 504

by adjusting on the two Allen screws on either side of the vernier scale

(1c) Tighten the two Allen screws below the dust cover and replace the cover and the four securing screws.

(e) Remove the position gauge from the tool coupling shaft.

(4) Install the optical measuring tool:

(a) Set the throttle lever to 'idle'.

(b) Engage the optical measuring tool with the No. 1 throttle channel in the transmitter racking.

(c) Using the knurled nut and turning it clockwise, screw the tool into engagement with the gearbox of the transmitter racking and lock the clamp plate.

NOTE: As the knurled nut is rotated it drives the tool into position, making the mechanical coupling and finally locking the tool into the racking.

(5) Check the setting of the No. 1 throttle:

(a) Hold the No. 1 throttle lever lightly against the idle stop, and check the reading on the tool, it should be between 35 deg 50 min and 36 deg 10 min. Where this reading is not achieved adjust the rod.

(6) Repeat the check using the optical measuring tool.

(7) Check that the tolerance of 35 deg 50 min to 36 deg 10 min includes the system backlash by moving the throttle lever forward and then back against the idle stop.

(8) Lock the rod:

(a) At the top of the rod, arrange the locking washer in the slot of the rod and, with the rod held firmly, tighten and torque load the locknut to between 30 and 36 lbf in (0.34 and 0.40 mdaN).

(b) At the bottom of the rod hold the eye-end

firmly and tighten the quick-release nut to between 30 and 36 lbf in (0.34 and 0.40 mdaN).

(c) Arrange the locking washers in the slots of the quick-release nut.

<u>WARNING:</u> THE LUG ON THE LOCKWASHER MUST FACE FORWARD.

(d) With a spanner on the quick-release nut torque tighten the locknut to between 10 and 15 lbf in (0.11 and 0.17 mdaN).

(e) Check that the throttle lever eye-end blocks the inspection hole in the rod.

(f) Lock the locknuts at both the top and bottom of the rod with wire.

(9) Repeat the checks on the rod setting using the optical measuring tool.

(10) Remove the optical measuring tool; rotate the knurled nut anti-clockwise until the tool is free.

(11) Install the four throttle transmitters (Ref.76-11-12, Removal/Installation).

D. Conclusion

(1) Check that the area is clean, release the locking struts, and hinge forward the crate. Insert the two securing screws and torque load them to between 70 and 80 lbf in (0.79 and 0.90 mdaN).

(2) Engage the check list stowage with the rear of the crate, fit and tighten the securing screws.

(3) Replace the centre console aft right-hand side panel:

(a) Check the seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilots' floor illumination at the receptacle identified U2025 on the panel.

(d) Torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(4) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the release pin.

(5) Secure the centre console aft left-hand side panel in a manner similar to that described for the right-hand panel. The electrical plug is identified U2026.

(6) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(7) If necessary, replace the co-pilots' seat (Ref. 25-11-21, Removal/Installation).

(8) Remove the locking pins (2) from the droop nose.

(9) Remove the safety clips and reset the circuit breakers previously tripped.

(10) Check that the pilots' floor illumination is satisfactory.

(11) Carry out an operational test for freedom of movement of the throttle levers (Ref. para 5)

3. Idle Stop Adjustment

NOTE: The idle stop is set on initial installation of the throttle assembly and should not alter in service.

A. Equipment and Materials.

DESCRIPTION	PART NO.
Torque spanner range: 0-70 lbf in (0-0.78 mdaN)	-
Circuit breaker safety clips	-
Loctite grade E and Locquic N (Ref.20-30-00, Nos. 112 and 120)	-

B. Preparation

(1) Trip the appropriate circuit breakers and secure

them with safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALT THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
PP MGT LTS SUP	5-213	1E461	D 1
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALT THROT CONT	15-215	2K4	F15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
PP MGT LTS SUP	1-213	2E461	E 3
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALT THROT CONT	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6
REHEAT CONT	15-215	3K1542	D16
PP MGT LTS SUP	1-213	3E461	E 4
ENG 4			
MAIN THROT CONT	3-213	4K3	A 2
ALT THROT CONT	15-216	4K4	F11
REV THRUST CONT	3-213	4K331	D 2
REHEAT CONT	15-216	4K1542	E10
PP MGT LTS SUP	5-213	4E461	D 2
AT SYS 1 SUP	13-215	1C179	C 6
AT SYNCHRO SYS 1 SUP	13-215	1C181	D 5
AT 1 CONT	1-213	1C180	Q12
AFCS 1 CONT	1-213	1C19	Q14
AT SYS 2 SUP	13-216	2C179	D16
AT SYNCHRO SYS 2 SUP	13-216	2C181	B17
AT 2 CONT	5-213	2C180	A14
AFCS 2 CONT	5-213	2C19	A12
CHART STOWAGE LTS SUP	15-216	L237	D12

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
NOSE 7 1/2 deg. CONT	1-213	M12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17

C. Adjustment (Ref. Fig. 503)

(1) Set the forward thrust lever to idle.

(2) Raise the reverse thrust lever to fully engage the idle lock tongue in the corresponding slot in the gate.

(3) Adjust the thickness of the idle stop spacer for the forward thrust lever, so that the fore and aft free play of the forward thrust lever is restricted to between 0.002 and 0.005 in (0.051 and 0.127 mm) measured at the idle stop.

(4) Coat the threads with 'Loctite' and 'Locquic' and torque load the idle stop bolt to between 60 and 70 lbf in (0.67 and 0.78 mdaN).

(5) Repeat the check on throttle lever movement to ensure that this is still between .002 and .005 in (0.051 and 0.127 mm).

(6) Return the reverse thrust lever to off.

D. Conclusion

(1) Carry out a throttle system mechanical input test and adjust as necessary (Ref. para 6).

(2) Check the setting of the forward thrust switches (Ref. 76-15-12, Adjustment/Test) and adjust as necessary.

(3) Remove the safety clips and reset the circuit breakers previously tripped.

4. <u>Maximum Thrust Stop Adjustment</u>

<u>NOTE:</u> The maximum thrust stop is set on initial installa-

tion of the throttle assembly and should not require adjustment in service unless a forward thrust lever is replaced.

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner range: 0-70 lbf in (0-0.78 mdaN)	-
Circuit breaker safety clips	-
Loctite grade E and Locquic N (Ref. 20-30-00, Nos. 112 and 120)	-

B. Preparation (Ref. Fig.501 and 502)

(1) Trip the appropriate circuit breakers and secure them with safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALT THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
PP MGT LTS SUP	5-213	1E461	D 1
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALT THROT CONT	15-215	2K4	F15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
PP MGT LTS SUP	1-213	2E461	E 3
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALT THROT CONT	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
REHEAT CONT	15-215	3K1542	D16
PP MGT LTS SUP	1-213	3E461	E 4
ENG 4			
MAIN THROT CONT	3-213	4K3	A 2
ALT THROT CONT	15-216	4K4	F11
REV THRUST CONT	3-213	4K331	D 2
REHEAT CONT	15-216	4K1542	E10
PP MGT LTS SUP	5-213	4E461	D 2
AT SYS 1 SUP	13-215	1C179	C 6
AT SYNCHRO SYS 1 SUP	13-215	1C181	D 5
AT 1 CONT	1-213	1C180	Q12
AFCS 1 CONT	1-213	1C19	Q14
AT SYS 2 SUP	13-216	2C179	D16
AT SYNCHRO SYS 2 SUP	13-216	2C181	B17
AT 2 CONT	5-213	2C180	A14
AFCS 2 CONT	5-213	2C19	A12
CHART STOWAGE LTS SUP	15-216	L237	D12
NOSE 7 1/2 deg. CONT	1-213	M12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17

(2) Remove the centre console aft left-hand side panel:

(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilots' floor illumination at the receptacle identified U2026 on the panel.

(c) Remove the panel.

(3) Remove the droop nose emergency lever (Ref. Fig. 501):

<u>NOTE:</u> This can be done with the nose either up or down.

(a) If the nose is up fit pins (2) in the droop nose uplocks.

NOTE: No pin is required if the nose is down.

(b) Using the ring pull the release pin outwards at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the left-hand side and depress the spring loaded pin on the forward end of the droop nose emergency lever; remove the lever.

(4) Remove the centre console aft right-hand side panel in a manner similar to that described for the left-hand; the electrical plug identification is U2025.

(5) Remove the centre console forward side panels.

(6) Remove the screws securing the check list stowage, remove the stowage.

(7) Remove the screws securing the crate; hinge back the crate.

(8) Unscrew the knurled nuts to extract the four throttle transmitters.

(9) Insert the tool for measuring rotation of the transmitter drive coupling.

C. Adjustment

(1) Move the forward thrust lever forward and hold it lightly against the maximum thrust stop.

(2) Check that the reading on the test equipment is between 0 deg and minus 0 deg 20 min.

(3) Adjust the maximum thrust stop by altering the thickness of the spacer behind the stop.

(4) Coat the threads with 'Loctite' and 'Locquic' and torque load the maximum thrust stop bolt to between 60 - 70 lbf in (0.67 and 0.78 mdaN).

(5) Re-check the reading on the optical measuring tool.

D. Conclusion

(1) Remove the tool for measuring rotation of the

transmitter drive coupling (Ref. para 2).

(2) Install the four throttle transmitters (Ref. 76-11-12, Removal/Installation).

(3) Check that the area is clean, release the locking struts, and hinge forward the crate. Insert the two securing screws and torque load them to between 70 and 80 lbf in (0.78 and 0.89 mdaN).

(4) Engage the check list stowage with the rear of the crate; fit and tighten the securing screws.

(5) Replace the centre console aft right-hand side panel:

(a) Loosely engage the panel.

(b) Connect the pilots' floor illumination at the receptacle identified U2025 on the panel.

(c) Torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(6) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the release pin.

(7) Secure the centre console aft left-hand side panel in a manner similar to that described for the right-hand panel, the electrical plug is idented U2026.

(8) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(9) Remove the safety clips and reset the circuit breakers previously tripped.

5. Operational Test

A. Test for Freedom of Movement

(1) For this test the reverse thrust lever must be in the off, fully forward and down, position.

(2) Move the forward thrust lever slowly over the whole range of movement from idle to maximum thrust and back again, the movement should be smooth and continuous. Any tendency to hesitate or stick is to be investigated. In particular check that a clearance exists between the forward idle lock tongue and the gate throughout full travel of the forward thrust lever. If for any reason the throttle friction is suspect carry out the friction test (Ref. 76-11-15, Adjustment/Test).

6. Throttle System Mechanical Input Test

A. Equipment and Materials

DESCRIPTION	PART NO.
Optical measuring tool	QV6A01
Gauge, position	QG6A01
Torque spanner range: 0-80 lbf in (0-0.89 mdaN)	-
Circuit breaker safety clips	-
Corrosion resistant steel locking wire 0.031 in (0.8 mm) dia	DTD189
Test set	QT6A15/24
Screwdriver (Torque set)	

B. Preparation (Ref. Fig.501 and 502)

(1) Trip the appropriate circuit breakers and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALT THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
PP MGT LTS SUP	5-213	1E461	D 1
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALT THROT CONT	15-215	2K4	F15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
PP MGT LTS SUP	1-213	2E461	E 3
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALT THROT CONT	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6
REHEAT CONT	15-215	3K1542	D16
PP MGT LTS SUP	1-213	3E461	E 4
ENG 4			
MAIN THROT CONT	3-213	4K3	A 2
ALT THROT CONT	15-216	4K4	F11
REV THRUST CONT	3-213	4K331	D 2
REHEAT CONT	15-216	4K1542	E10
PP MGT LTS SUP	5-213	4E461	D 2
AT SYS 1 SUP	13-215	1C179	C 6
AT SYNCHRO SYS 1 SUP	13-215	1C181	D 5
AT 1 CONT	1-213	1C180	Q12
AFCS 1 CONT	1-213	1C19	Q14
AT SYS 2 SUP	13-216	2C179	D16
AT SYNCHRO SYS 2 SUP	13-216	2C181	B17
AT 2 CONT	5-213	2C180	A14
AFCS 2 CONT	5-213	2C19	A12
CHART STOWAGE LTS SUP	15-216	L237	D12

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
NOSE 7 1/2 deg. CONT	1-213	M12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17

C. Test

(1) Insert the tool for measuring rotation of the transmitter drive coupling.

(2) Hold the forward thrust lever lightly against the idle stop and check the reading on the test equipment, it should be between 35 deg 50 min and 36 deg 10 min.

(3) Move the forward thrust lever to maximum thrust and hold it lightly against the stop. The reading on the test equipment should be between 0 deg and minus 0 deg 20 min.

(4) Check that the tolerance of 35 deg 50 min to 36 deg 10 min includes the system backlash by moving the forward thrust lever forward and then back against the idle stop.

(5) If these settings are not achieved adjust as in para 2 and 4.

(6) Remove the optical measuring tool.

(7) Install the throttle transmitters (Ref. 76-11-12, Removal/Installation).

(8) Carry out the friction test (Ref. 76-11-15, Adjustment/Test).

D. Conclusion

(1) Check that the area is clean, release the locking struts, and hinge forward the crate. Insert the two securing screws and torque load them to between 70 and 80 lbf in (0.78 and 0.89 mdaN).

(2) Engage the check list stowage with the rear of the crate, fit and tighten the securing screws.

(3) Replace the centre console aft right-hand side panel:

(a) Check the seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilots' floor illumination at the receptacle identified U2025 on the panel.

(d) Torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(4) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the release pin.

(5) Secure the centre console aft left-hand side panel in a manner similar to that described for the right-hand panel. The electrical plug is identified U2026.

(6) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(7) If necessary, replace the co-pilots' seat (Ref. 25-11-21, Removal/Installation).

(8) Remove the locking pins (2) from the droop nose.

(9) Remove the safety clips and reset the circuit breakers previously tripped.

(10) Check that the pilots' floor illumination is satisfactory.

(11) Carry out an operational test for freedom of movement of the throttle levers (Ref. para 5)

7. Tools and Equipment

Test set	PE.35480
Insulation resistance tester (use with PE.35480) with range covering 0 to 3 M ohms for insulation tests	-
Test set (with three cables)	QT 6A15/24A or QT 6A15/24B
Circuit breaker safety clip...	-

8. Fault Locating Tests (Ref.Fig.505)

A. Prepare for Tests Using Test Set PE.35480.

(1) Electrically isolate the engine services indicated in Table 501 by tripping the circuit breakers affecting the engine systems upon which tests are to be carried out. Attach safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
Engine No.1			
MAIN THROT SUP	2-213	1K1	F12
MAIN THROT CONT	3-213	1K3	A1
ALTN THROT SUP	14-215	1K2	G12
ALTN THROT CONT	15-216	1K4	E8
Engine No.2			
MAIN THROT SUP	2-213	2K1	C12
MAIN THROT CONT	1-213	2K3	A3
ALTN THROT SUP	13-215	2K2	F14
ALTN THROT CONT	15-215	2K4	F15

Circuit Breakers
Table 501 (Continued)

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
Engine No.3			
MAIN THROT SUP	2-213	3K1	C13
MAIN THROT CONT	1-213	3K3	A4
ALTN THROT SUP	13-216	3K2	A7
ALTN THROT CONT	15-215	3K4	F16
Engine No.4			
MAIN THROT SUP	2-213	4K1	F13
MAIN THROT CONT	3-213	4K3	A2
ALTN THROT SUP	14-216	4K2	C7
ALTN THROT CONT	15-216	4K4	F11

Circuit Breakers
Table 501 (Concluded)

(2) Remove flight plug and connect the test set cable to the control amplifier socket SK 1. Ensure the pins align with their respective sockets and make the connection carefully to avoid damage.

(3) Set the circuit breakers indicated in Table 501.

(4) Ensure THROTTLE MASTER switch is set to OFF.

(5) Set test set rotary switch to position 1 and note the meter reading. The meter reading should be 50, if necessary unscrew the SET LEVEL cover and adjust the SET LEVEL to obtain a reading of 50. Replace the cover.

B. Carry Out Tests.

<u>NOTE:</u> Confirmation of the test set integrity may be carried out if its performance is suspect during the following tests as detailed in paragraph C.

CR 35730/00A

SET LEVEL
0 20 40 60 80 100
SHORT CIRCUIT
OPEN CIRCUIT
FUSE
SET LEVEL
INSULATION
SET LEVEL

SWITCH POS'N	CHECK
3	Tj THERMOCOUPLE
4-9	THROTTLE ACTUATOR
10-15	NOZZLE TRIM
16-17	Ti BULB
18-20	PILOTS LEVER
21	N2 PULSE PROBE
22	N1 PULSE PROBE
23-24	N1 MANUAL RE-SET
25	DC SUPPLY *

* THROTTLE MASTER ON

SOCKET 2

SOCKET 1

ENGINE CONTROL AMPLIFIER
TYPE A6A 16/24CA

F.I.M. INDICATORS

F I D I S P L A Y

SOCKET 2

SOCKET 1

RESET PUSH BUTTON

ENGINE CONTROL AMPLIFIER
TYPE A6A 16/24CC AND /24DC

1
2
4
8

1,4 AND 8 ILLUMINATED
∴ 1+4+8 = CODE 13

EXAMPLES OF FAULT IDENTIFICATION CODE

Fault Locating Test Set Application
Figure 505

R B (1) For a satisfactory test the meter reading must be within the values of 20 to 80. A reading outside these values indicates an earth fault in the engine control system.

(2) When an earth fault is indicated, carry out insulation resistance checks as follows;

(a) Disconnect test set and remove amplifier from electrical racking.

(b) Connect one lead of the insulation resistance tester to a convenient earth point on the electrical racking.

(c) With the exception of the T_J thermocouple amplifier rack pin connections, connect the other insulation resistance tester lead to each pin connection listed in Table 502 in turn and check insulation resistance. To be acceptable, the resistance reading must not be less than 2 M ohms at each pin connection.

(d) If all readings are satisfactory, renew the amplifier and repeat the test procedure detailed in paragraph B.(1).

(e) One or more unsatisfactory readings are indicative of an earth fault in the associated aircraft wiring or system component (Ref. Table 502). Locate and rectify the defect.

(f) On completion of satisfactory checks, disconnect insulation resistance tester, install amplifier and reconnect the test set.

(3) Ensure that any earth faults detected in (1) are corrected before continuing with the tests.

R B (4) For satisfactory tests, the meter reading must be between the values of 20 to 80 (green band) at switch positions 3 to 22, except at positions 16 and 17 where the values must be between 45 to 60 (lower narrow green band).

R B A fluctuating meter reading will probably result if the THROTTLE MASTER switch has not been selected OFF.

(5) Set THROTTLE MASTER switch to lane under test, MAIN or ALTERN.

NOTE: On selection of THROTTLE MASTER switch to a faulty control lane, the throttle warning systems will operate.

(6) Set rotary switch to position 25 and note the meter reading. For a satisfactory test, the reading must be between 30 and 90. If a fault is detected and the integrity of the test set is in doubt, without further movement of the rotary switch, carry out the procedure detailed in paragraph 8.D.

(7) A zero meter reading indicates a short circuit while a full scale reading indicates an open circuit. It is acceptable, under either of these conditions, for the meter needle to be hard against the meter end stop. The reading gained at position 25 confirms the presence of a d.c. voltage supply. The lower limit, 30, corresponds approximately to 18 V d.c. while a reading of 75 corresponds approximately to 28 V d.c.

Switch Position	Function	Nominal D.C. Resistance	Amplifier Rack Pin Connections
1	Check A.C. and Set Level	-	-
2	Check Insulation	-	-
3	T_J Thermocouple	120 ohms	AB11; AB22
4	T.A. Motor Control	2 ohms	AC5 ; AC51
5	T.A. Motor Reference	35 ohms	AC54; AC5
6	T.A. Brake	2 ohms	AC57; AC2
7	T.A. Tacho Signal	800 ohms	AC46; AC35
8	T.A. Tacho/P.F.B. Reference	43 ohms	AC48; AC2
9	T.A. P.F.B. Signal	130 ohms	AC32; AC43
10	N.T. Motor Control	2 ohms	AC5 ; AC13
11	N.T. Motor Reference	35 ohms	AC16; AC5
12	N.T. Brake	2 ohms	AC5 ; AC2
13	N.T. Tacho Signal	800 ohms	AC40; AC29
14	N.T. Tacho/P.F.B. Reference	66 ohms	AC2 ; AC24
15	N.T. P.F.B. Signal	220 ohms	AC10; AC21
16	T_1 Bulb - Main Wire	138 ohms	AB36; AB28

Fault Locating
Table 502 (Continued)

Switch Position	Function	Nominal D.C. Resistance	Amplifier Rack Pin Connections	
17	T_1 Bulb - 3rd Wire	138 ohms	AB36;	AB17
18	Pilots Lever Positioner Signal	2250 ohms	AC28;	AC34
19	Pilots Lever Governor	2250 ohms	AC31;	AC20
20	Pilots Lever Reference	220 ohms	AC53;	AC55
21	N_2 Pulse Probe	480 ohms	AB42;	AB31
22	N_1 Pulse Probe	480 ohms	AB34;	AB45
23	Not In Use	-	-	-
24	Not In Use	-	-	-
25	28 Volt D.C. Supply	-	AA32	

Fault Locating
Table 502 (Concluded)

(8) A faulty circuit can be identified by means of the list on the test set panel. For more detailed analysis, if required, refer to Table 502 for a complete list of functions checked.

(9) On completion of satisfactory tests, carry out procedure detailed in paragraph E.

C. Intermittent Control System Failure Which Proves Difficult to Diagnose

(1) Establish interphone communication between the flight deck and the required engine bay.

(2) On the flight deck select, in turn, test set switch positions 10 to 15 (Nozzle trim).

(3) At the PN trim unit, grasp the appropriate connector clamp, MAIN or ALT, and firmly flex the connector back-shell.

(4) Note the test meter reading at each of the six switch positions.

(5) If an unstable reading on the test meter is observed, coinciding with the flexing action, re-tighten the connector in accordance with WDM 20-42-48 and repeat the test

(6) If the problem persists, visually inspect both halves of the connector. If the fixed half is satisfactory, check the harness plug for reasonable pin friction (as a guide not less than 2oz/56.7g) using a slave pin of the correct size. If sufficient frictional contact is noted, change the offending individual socket contact(s). Also check that the socket contacts have not been pushed back. If the free half is damaged or, in the case of a pushed back contact, damage to the contact retention tines is suspected, replace the complete plug and retest.

NOTE: If an individual socket contact is replaced, care should be taken to ensure that the conductor length has not been reduced sufficient to place undue strain on that particular wire in the harness. If the latter applies, either lengthen the cable using the appropriate splice or if harness length is sufficient remake all the socket contacts on the connector concerned to maintain an even cable length in the harness.

(7) If the readings for both connectors on the PN trim unit prove satisfactory, carry out similar checks on the following units using the test set switch positions shown:

Unit	Switch Position
Throttle Valve Actuator Gearbox	4 to 9
N1 Pulse Probe	22
N2 Pulse Probe	21

(8) The flexing procedure can also be applied to the T1 probe NAS 1599 type connector in the intake diffuser roof. When an intermittent signal is observed on this connector with test set switch at positions 16 and 17, it should be actioned in accordance with 76-11-14, Inspection/Check.

D. Test Set Integrity Check.

(1) Transfer test set to other control lane.

(a) Trip circuit breakers indicated in Table 501.

(b) Disconnect test set cable and reconnect cable to socket SK1 of the other control amplifier, MAIN or ALTERN as applicable, (Ref.para.8.A.(2)).

(c) Reset the circuit breakers indicated in Table 501.

(2) When an integrity check requirement arises with the rotary switch in any position from 3 to 24, ensure the THROTTLE MASTER switch is OFF.

(3) When an integrity check requirement arises with the rotary switch in position 25, set the THROTTLE MASTER switch to the amplifier now connected to the test set.

(4) Note the meter reading. A satisfactory reading confirms the fault detected in the other control lane.

E. Complete the Test Procedure.

(1) Ensure THROTTLE MASTER switch is set to OFF.

(2) Trip the engine control system circuit breakers (Ref. Table 501).

(3) Disconnect test set cable from amplifier and install the flight plug. Install the flight plug on the other amplifier if an integrity check on the test set has been carried out.

(4) Reset the engine control system circuit breakers.

(5) Select THROTTLE MASTER switch to the amplifier(s) with re-installed flight plugs and check that the throttle failure warning is not activated. Select the switch to OFF.

(6) On type /24CC and /24DC amplifiers with an operative FIM, press the reset button and check that all indicator code lights illuminate, then release the button and check that the indicators extinguish. If any indicators remain illuminated, a defect exists and should be checked as detailed in paragraph 13.

9. Test Set (Ultra QT.6A15/24A and 24B) Confidence Checks (Ref.Figs.505 and 506)

A. General.

(1) Confidence checks are to be carried out when it is necessary to confirm the serviceability of the test set. The preparation must be carried out before commencing the confidence checks. The specific confidence checks are given as a continuation of the preparation and can be carried out separately or in any sequence.

(2) Illumination of the DS lamp during the check procedure, other than for the lamp operation tests, indicates a distorted power supply which can give unreliable results. No checks or adjustments, other than fault interrogation and the safety system check, are to be carried out until the fault is rectified.

B. Test Set Preparation for Confidence Check Procedures.

(1) Electrically isolate the air intake control system and the engine services for the engine upon which tests are to be carried out by tripping the circuit breakers given in Table 503. Attach safety clips.

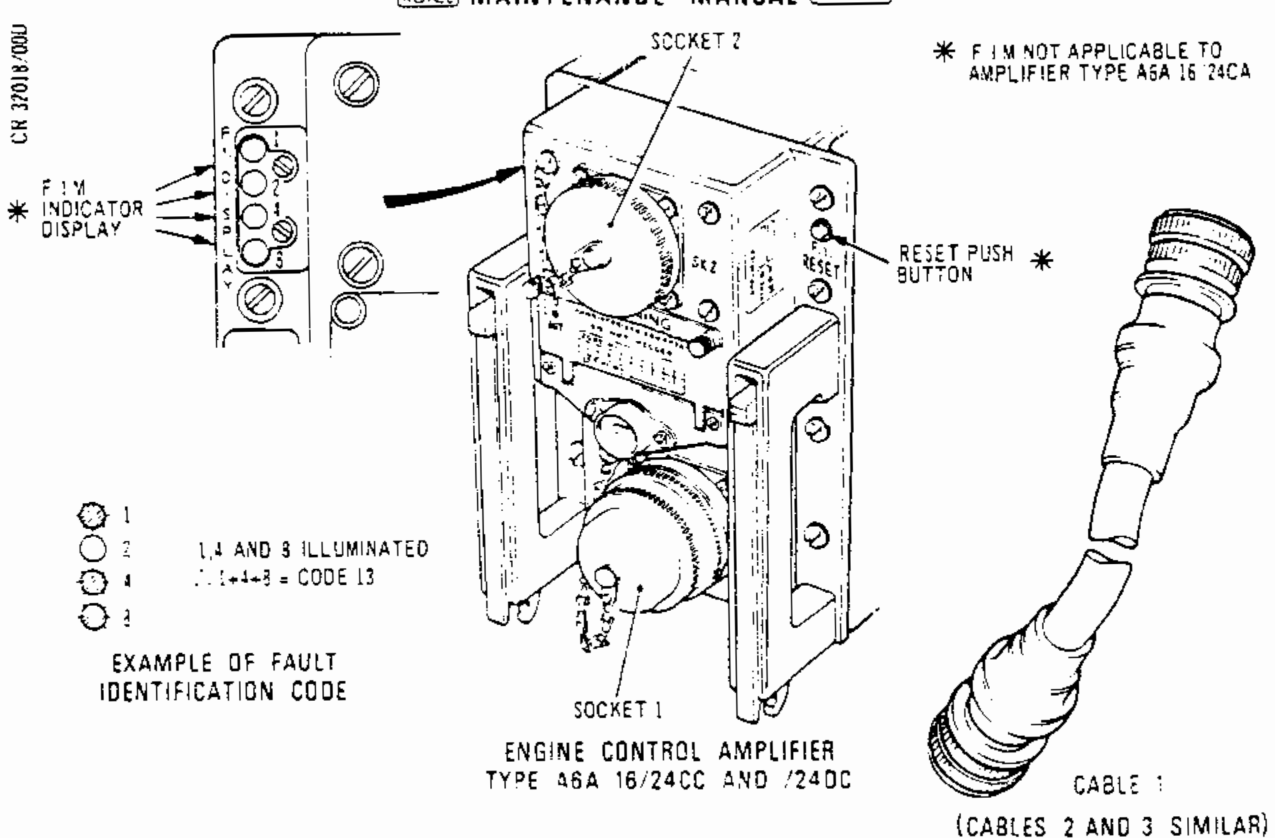
WARNING: WHENEVER ENGINE HP CONTROL CIRCUIT BREAKER IS TO BE TRIPPED OR HP VALVE SWITCH IS SET TO OPEN, FIRST TRIP ASSOCIATED T_1 PROBE HEATER CIRCUIT BREAKER AND PREVENT UNNECESSARY HEATER OPERATION. HEATER(S) WOULD BE SWITCHED ON AND ATTAIN OPERATING TEMPERATURE WITHIN 30 SECONDS OF HP VALVE SWITCH OR CIRCUIT BREAKER OPERATION.

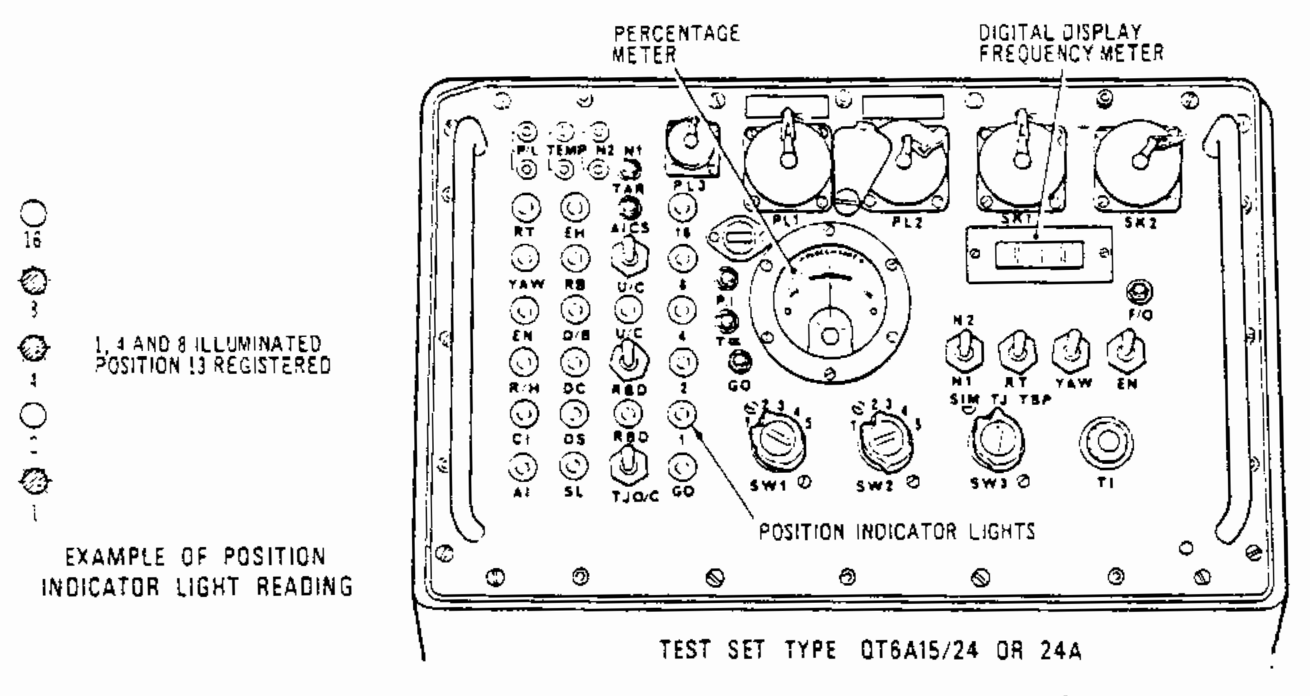
SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
Engine No.1			
AICU 1A SUP	2-213	1K2050	D14
AICU 1B SUP	14-216	1K2051	A5
T1 PROBE HTR SUP	13-215	1H542	C9
RH IGNITION SUP	1-213	1J4	N5
LH IGNITION SUP	2-213	1J3	E12
REHEAT IGNITION SUP PH A	14-215	1K1543	B13
REHEAT IGNITION SUP PH C	14-215	1K1544	F12
START FUEL PUMP SUP	1-213	1Q812	J6
RH UC WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH UC WEIGHT SW 'B' SYS SUP	3-213	G293	B8
HP VALVE CONT	3-213	1K131	C1
Engine No.2			
AICU 2A SUP	13-216	2K2050	A3
AICU 2B SUP	2-213	2K2051	H14
T1 PROBE HTR SUP	14-215	2H542	E8
RH IGNITION SUP	1-213	2J4	P5
LH IGNITION SUP	2-213	2J3	B10
REHEAT IGNITION SUP PH A	13-215	2K1543	A14
REHEAT IGNITION SUP PH C	13-215	2K1544	E14
START FUEL PUMP SUP	1-213	2Q812	K6
RH UC WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH UC WEIGHT SW 'B' SYS SUP	3-213	G293	B8
HP VALVE CONT	1-213	2K131	C3

Circuit Breakers
Table 503 (Continued)

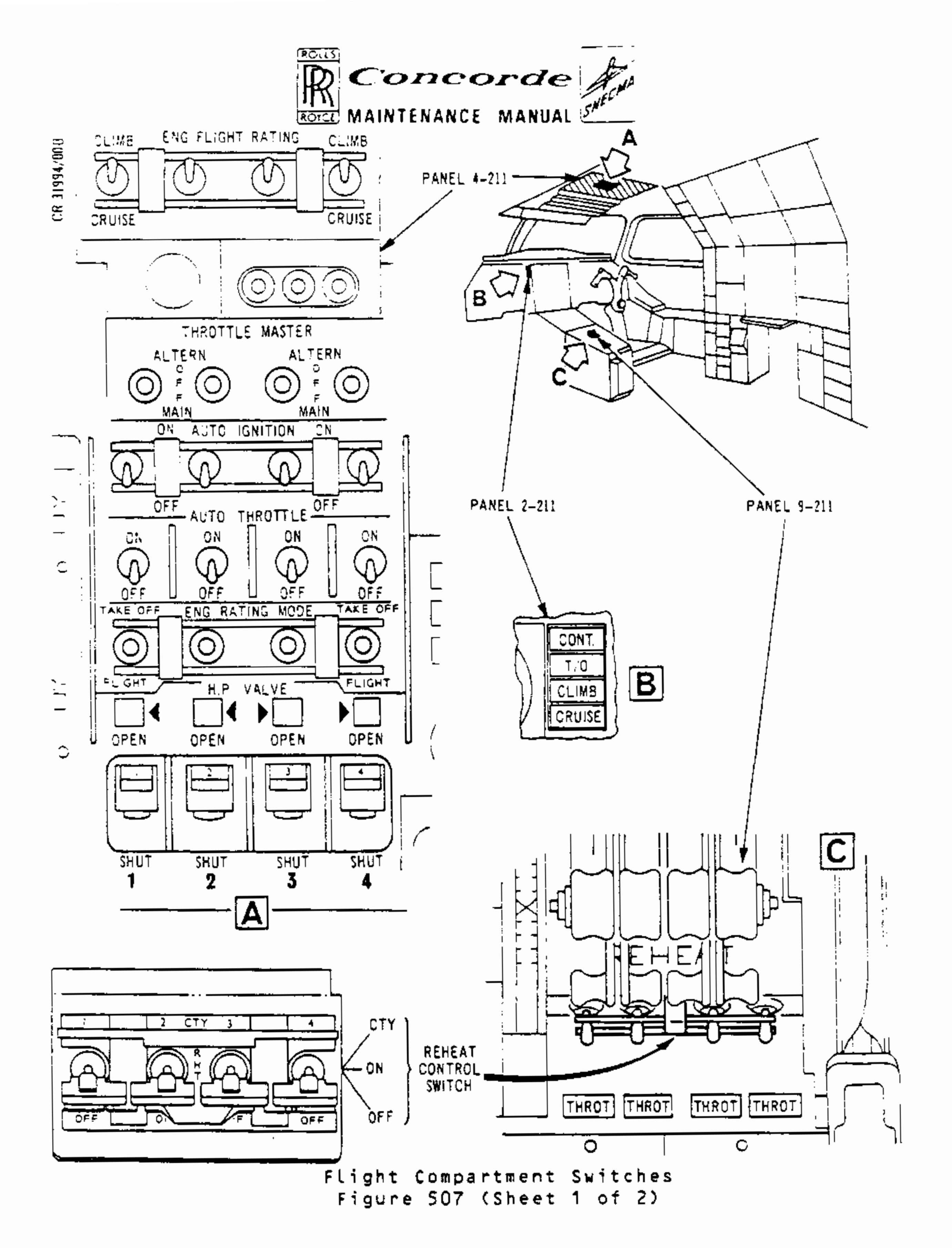
SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
Engine No.3			
AICU 3A SUP	2-213	3K2050	H13
AICU 3B SUP	13-216	3K2051	B3
T1 PROBE HTR SUP	14-216	3H542	C14
RH IGNITION SUP	1-213	3J4	Q5
LH IGNITION SUP	2-213	3J3	B11
REHEAT IGNITION SUP PH A	13-216	3K1543	A5
REHEAT IGNITION SUP PH C	13-216	3K1544	F6
START FUEL PUMP SUP	1-213	3Q812	L6
RH UC WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH UC WEIGHT SW 'B' SYS SUP	3-213	G293	B8
HP VALVE CONT	1-213	3K131	C4
Engine No.4			
AICU 4A SUP	14-216	4K2050	B5
AICU 4B SUP	2-213	4K2051	B14
T1 PROBE HTR SUP	13-216	4H542	C11
RH IGNITION SUP	1-213	4J4	R5
LH IGNITION SUP	2-213	4J3	E13
REHEAT IGNITION SUP PH A	14-216	4K1543	A6
REHEAT IGNITION SUP PH C	14-216	4K1544	E7
START FUEL PUMP SUP	1-213	4Q812	M6
RH UC WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH UC WEIGHT SW 'B' SYS SUP	3-213	G293	B8
HP VALVE CONT	3-213	4K131	C2

Circuit Breakers
Table 503 (Concluded)



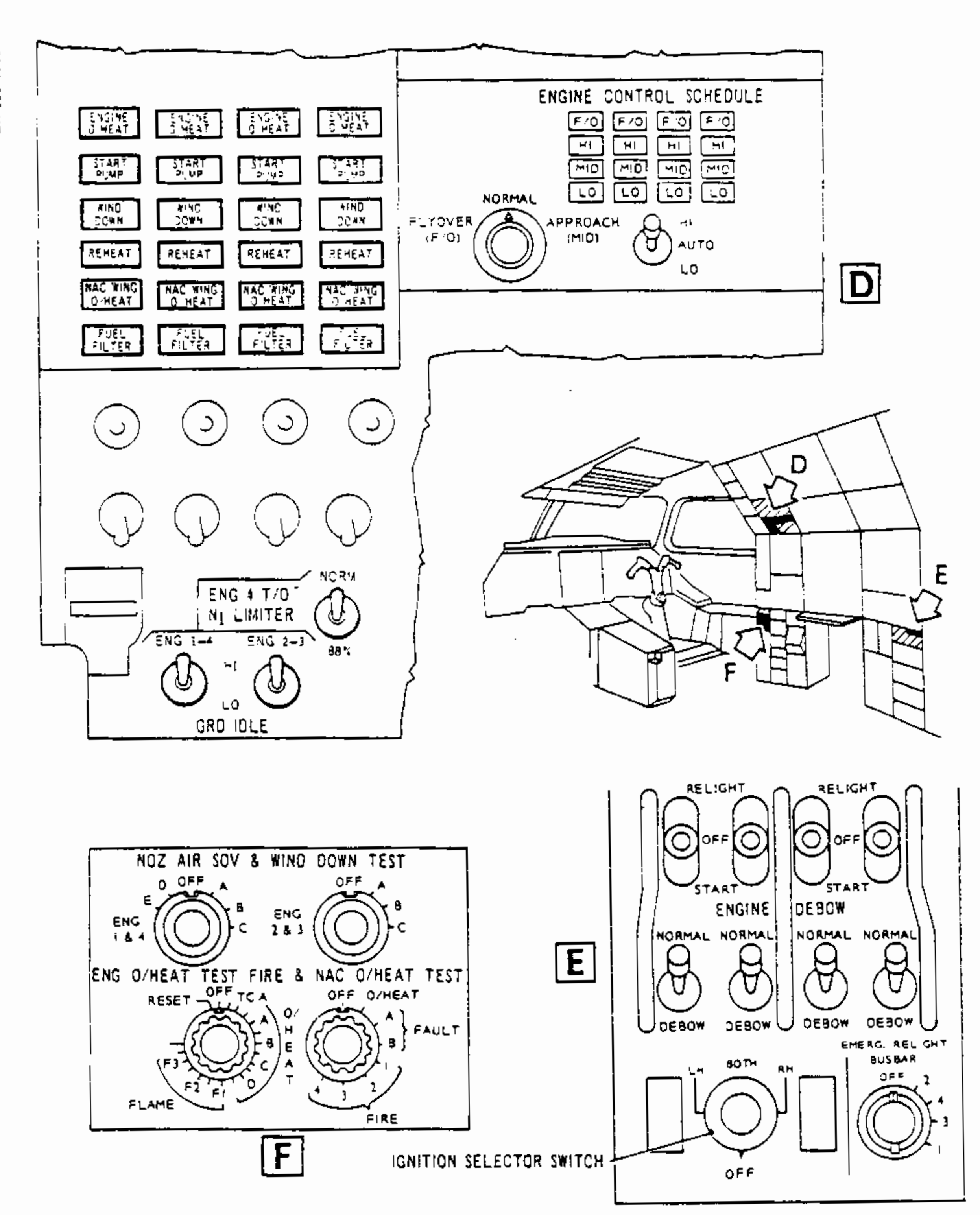


Type QT A6A15/24A and B Test Set Application
Figure 506



Flight Compartment Switches
Figure 507 (Sheet 1 of 2)

CR 32017/00C



Flight Compartment Switches
Figure 507 (Sheet 2 of 2)

(2) Make the following flight compartment switch selections.

ENG FLIGHT RATING	-	CLIMB
ENG RATING MODE	-	TAKE OFF
ENGINE CONTROL SCHEDULE	-	NORMAL AND LO
GRD IDLE	-	HI
ENG 4 T/O N_1 LIM	-	NORM
START/RELIGHT	-	OFF
AUTO IGNITION	-	OFF
Ignition selector	-	OFF
Pilots throttle lever	-	IDLE
THROTTLE MASTER	-	OFF

(3) Make the following test set switch selections.

SW 1	-	position 1
SW 2	-	position 1
SW 3	-	SIM
N_2/N_1	-	N_2
Remainder	-	to up position

(4) Trip engine control system circuit breakers (Ref. Table 504).

(5) Remove flight plug, relevant plug and socket covers and connect cable 3 between test set plug PL 3 and amplifier socket SK 1.

C. Lamp, Fault Interrogation and Pilots Lever Confidence Checks.

(1) Carry out the preparation procedure detailed in paragraph B.

(2) Remove relevant plug and socket covers and connect cable 1 between test set plug PL 1 and test set socket SK 1.

(3) Set the engine control system supply circuit breaker (Ref. Table 504).

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No.1			
MAIN THROT SUP	2-213	1K1	F12
MAIN THROT CONT	1-213	1K3	A1
ALTN THROT SUP	14-215	1K2	G12
ALTN THROT CONT	15-216	1K4	E8
Engine No.2			
MAIN THROT SUP	2-213	2K1	C12
MAIN THROT CONT	1-213	2K3	A3
ALTN THROT SUP	13-215	2K2	F14
ALTN THROT CONT	15-215	2K4	F15
Engine No.3			
MAIN THROT SUP	2-213	3K1	C13
MAIN THROT CONT	1-213	3K3	A4
ALTN THROT SUP	13-216	3K2	A7
ALTN THROT CONT	15-215	3K4	F16
Engine No.4			
MAIN THROT SUP	2-213	4K1	F13
MAIN THROT CONT	3-213	4K3	A2
ALTN THROT SUP	14-216	4K2	C7
ALTN THROT CONT	15-216	4K4	F11

Circuit Breakers
Table 504

(4) Check that the position indicator lights register 30 and the GO lamp is illuminated. If necessary, press GO button to obtain indication of 30.

NOTE: If the lamp is not illuminated, check for lamp failure or supply distortion.

(5) Set switch 1 to position 5, check that all position indicator lamps, 1, 2, 4, 8 and 16, and lamps GO, DC, DB, RH, DS, A1, C1, RB and EH illuminate and frequency meter digital display reading is 8888.

(6) Set switch 1 to position 1 and press the GO button. Check that the GO lamp extinguishes and the test set runs through positions 1 to 30 where it stops and the GO lamp again illuminates to indicate a satisfactory check.

(7) Set switch 2 to positions 2 and 3 in turn and record the meter reading at each setting.

Acceptable limit (both) - plus 45% to plus 55%

(8) On completion of the check, trip the engine control system circuit breakers (Ref.Table 504), reset all switches, disconnect and remove cable 1 and replace socket and plug covers.

(9) If no further tests are required, complete the procedure as detailed in paragraph E.

D. Safety Check-Out, Lamp and Harmonic Distortion and Simulator Confidence Checks.

(1) Carry out the preparation procedure detailed in paragraph B.

(2) Remove relevant plug and socket covers and connect cable 2 between test set plug PL 2 and test set socket SK 2.

(3) Set the engine control circuit breakers (Ref. Table 504).

(4) Check that the position indicator lights register 30 and the GO lamp is illuminated.

<u>NOTE:</u> If the lamp is not illuminated, check or lamp failure or supply distortion.

(5) Set switch 1 to position 5 and check that Lamps GO, DS and SL illuminate and frequency meter digital display reading is 8888.

(6) Set switch 2 to position 4 and check that lamp RH illuminates.

(7) Set switch 1 to position 1, switch 2 to position 1 and press the GO button. Check that the GO lamp extinguishes and the test set runs through positions 1 to 30 with an intermediate stop at position 27. Check that GO lamp stops and illuminates at position 30 to indicate a satisfactory check. Restart after a stop by pressing the GO button.

(8) Check DS lamp is extinguished, set switch 1 to position 4 and check that DS lamp is illuminated.

(9) Set switch 1 to position 1 and switch 2 to position 5. In turn, select down and reset up switches EN, YAW, RT everse thrust) RBD everse buckets deployed) and U/C and check that the respective lamps illuminate when selected.

(10) Set switch 1 to positions 2 to 5 in turn, and observe the meter reading at each selection. The reading at each selection must be within the green zone to be acceptable.

(11) Set switch 1 to position 4 and switch 3 to position T_J and check meter reading. The reading must be within the green zone to be acceptable.

(12) Set switch 3 to position SIM, switch 1 to position 1 and record the meter reading.

Acceptable limit - plus 50% to plus 60%

(13) Set switch 2 to position 5 and record meter reading.

Acceptable limit - minus 5% to plus 5%

(14) On ompletion of a satisfactory check, trip circuit breakers (Ref.Table 504), reset all switches, disconnect and remove cable 2 and replace plug and socket covers.

(15) If no further tests are required, complete the procedure as detailed in paragraph E.

E. Complete the Procedure.

(1) Ensure the engine control system circuit breakers are tripped (Ref. Table 504).

(2) Disconnect and remove cable 3.

(3) Install flight plug and plug and socket covers.

(4) Reset engine control system circuit breakers, select the THROTTLE MASTER switch to the amplifier with the re-installed flight plug and check that the throttle failure warning is not activated. Set switch to OFF

10. Engine Control System Test Procedure (Ref.Fig.506, 507 and 508)

A. General.

The following checks apply to all three amplifier types except where the check is stated as specific to a type.

The type QT 6A15/24B test set is capable of the full range of checks, with the exception of the EGT warning check, for all three types of amplifier whereas the type /24A test set is not capable of the additional checks specific to the type A6A16/24CC and /24DC amplifiers.

The basic preparation procedure given in paragraph B preedes the initial check procedure of any sequence of checks that are to be carried out.

Checking procedures for use after an amplifier installation or following a malfunction when the throttle failure warning has not illuminated are given in paragraph C and checks required following a failure warning are given in paragraph D. Checks for switch or associated wiring defects are given in paragraph E.

B. Basic Preparation for Tests.

(1) Trip the circuit breakers indicated in Tables 503 and 504 and attach safety clips.

(2) Make the following flight compartment switch selections.

ENG FLIGHT RATING	-	CLIMB
ENG RATING MODE	-	TAKE OFF
ENGINE CONTROL SCHEDULE	-	NORMAL and LO
GRD IDLE	-	HI
ENG 4 T/O N_1 LIM	-	NORM
START/RELIGHT	-	OFF
AUTO IGNITION	-	OFF
Ignition selector	-	OFF
Pilots throttle lever	-	IDLE
THROTTLE MASTER	-	OFF

(3) Make the following test set switch selections.

SW 1	-	position 1
SW 2	-	position 1
SW 3	-	SIM
N?/N.	-	N_2
Remainder	-	to up position

C. Checks When Control Malfunction has Occurred and Throttle Failure Warning Has Not Illuminated.

NOTE: The checks given under this heading are applicable either when a defect is suspected or when it is desired to confirm the serviceability of an amplifier after installation.

(1) General.

(a) If oscillations of the meter needle occur between idle and 67% N_2, increase the pilot's throttle lever setting and return it slowly to the idle setting and establish stable conditions before commencing checks.

(b) Reheat selection is simulated by use of the reheat circuit breakers as detailed in the specific procedure.

(c) Procedures and limits stated apply to all three amplifier types except where an amplifier type and check applicability is specified.

(d) Permitted adjustments on an installed amplifier are given in paragraph 12 for the following datums.

Idle governor
N_2 limiter
EGT (T_J) limiter
N_1 root theta limiter.
N_1 Governor
Flame-out circuit
Maximum reverse thrust

(2) Ensure that the basic preparation given in paragraph B is complete and continue with the preparation specific to this test.

(a) Connect cable 2 between test set plug PL 2 and amplifier socket SK 2.

(b) Connect cable 3 between test plug PL 3 and amplifier socket SK 1.

(c) Reset the engine control system circuit breakers (Ref.Table 504).

(d) Set T_1 potentiometer to 378 divisions.

(e) Check that the position indicator lights register 30 and the GO lamp is illuminated. If necessary, press GO button to obtain indication of 30.

(f) Set THROTTLE MASTER switch to amplifier under test (MAIN OR ALTERN). Check that the throttle failure warning does not illuminate.

(3) Carry out idle governor and positioner datum checks.

(a) Set switch SW 2 to position 5 and T_1 potentiometer to 479 divisions.

(b) Record the frequency reading shown on the test set meter.

Acceptable limit - 2815 to 2858 Hz

(c) Set T_1 potentiometer to 000 divisions and record test set % meter reading.

(i) Type /24CA and /24CC amplifiers:

Acceptable limit - minus 30% to plus 30%

(ii) Type /24DC amplifiers:

Acceptable limit - minus 40% to plus 20%

(d) Select GRD IDLE switch to LO and record the test set % meter reading.

(i) Type /24CA and /24CC amplifiers:

Acceptable limit - minus 90% to minus 30%

(ii) Type /24DC amplifiers:

Acceptable limit - minus 100% to minus 40%

(e) Set T_1 potentiometer to 479 divisions and record the frequency reading shown on the test set meter.

Acceptable limit - 2815 to 2858 Hz

(f) On /24CC and /24DC amplifiers using test set type /24B, check reheat at idle. Reheat circuit breakers tripped simulated reheat on.

(i) Record frequency reading shown on the test set meter:

Acceptable limit - 2903 to 2945 Hz

(ii) Set T_1 potentiometer to 000 divisions and record reading on test set % meter.

Type /24CC amplifier acceptable limit - plus 30% to plus 90%

Type /24DC amplifier acceptable limit - plus 20% to plus 80%

(g) Select GRD DLE to HI and switch SW 2 to position 1 and continue with paragraph (4).

(4) Carry out N_2 limiter, T_J limiter and N_2/root theta limiter datum checks.

(a) Verify that cables are connected and switches set as specified in paragraph B and C(2).

(b) Make the following settings preparatory to this check.

(i) Move pilot's lever to MAX and verify that the THROTTLE MASTER switch is selected to the amplifier to be checked.

(ii) Set switch EN to the down position and the T_1 potentiometer to 945 divisions.

(c) Set the switches and record the readings obtained from the checks of paragraphs (g) to (h) using the following method.

(i) Reheat circuit breakers (Ref.Table 503), simulate reheat on when tripped and are set to simulate reheat off.

(ii) When switch SW 3 is at SIM, record the test set digital display frequency meter reading as N_2 Hz for comparison with the stated acceptable limit.

(iii) When swith SW 3 is at T_J, with the N_2/N_1 switch at N_2, record the test set digital display frequency meter reading as EGT °C. Set the N_2/N_1 switch to N_1, record the N_1% reading shown on the flight compartment indicator and reset the switch to N_2. Apply the EGT/N_1 value with the graph of the specified figure.

CR 34040/008

HP COMPRESSOR RPM (N_2)

FAILURE WARNING INDICATOR

LP COMPRESSOR RPM (N_1)

FAILURE WARNING INDICATOR

EGT INDICATOR

A

A

Flight Compartment Indication
Figure 508

(d) Set the reheat circuit breakers Ref.Table 503) and take readings at the following T_1 potentiometer and switch SW 3 settings.

T_1 Pot		SW 3		Acceptable Limit
945	-	SIM	-	N_2 - 472 to 4492 Hz
945	-	T_J	-	EGT/N_1 for type /24CA and /24CC amplifiers, use graph/Fig.509. For type /24DC amplifiers, use graph/Fig.509 when EGT switch is retained in position 1 and the graph/Fig.510 for switch position 2.
378	-	T_J	-	EGT/N_1 - Use graph/Fig.511
378	-	SIM	-	N_2 - 4394 to 4414 Hz
555	-	SIM	-	N_2 - 4423 to 4443 Hz
555	-	T_J	-	EGT/N_1 - Use graph/Fig.512

(e) With T_1 potentiometer at 555 divisions, trip the reheat circuit breakers and take readings at the following reheat switch and switch SW 3 settings.

R/H switch		SW 3		Acceptable Limit
CTY	-	T_J	-	EGT/N_1 - Use graph/ Fig.513
CTY	-	SIM	-	N_2 - 4476 to 4496 Hz
OFF	-	SIM	-	N_2 - 4375 to 4395 Hz
OFF	-	T_J	-	EGT - 708 to 734°C

(f) Set the reheat circuit breakers, select ENG FLIGHT RATING to CRUISE and take readings at the following switch SW 3 settings and T alpha button operation.

SW 3		T alpha button		Acceptable Limit
T_J	-	No	-	EGT - 690 to 716°C
SIM	-	No	-	N_2 - 4362 to 4382 Hz
SIM	-	Press	-	N_2 - 4309 to 4329 Hz
T_J	-	Press	-	EGT - 650 to 676°C

Continue with either paragraph (g) or paragraph (h).

CR 34041/008

MODE - TAKE OFF
RATING - CLIMB
T_J POT - 945 DIVISIONS
REHEAT - OFF (SIMULATED)

UPPER ACCEPTABLE LIMIT

LOWER ACCEPTABLE LIMIT

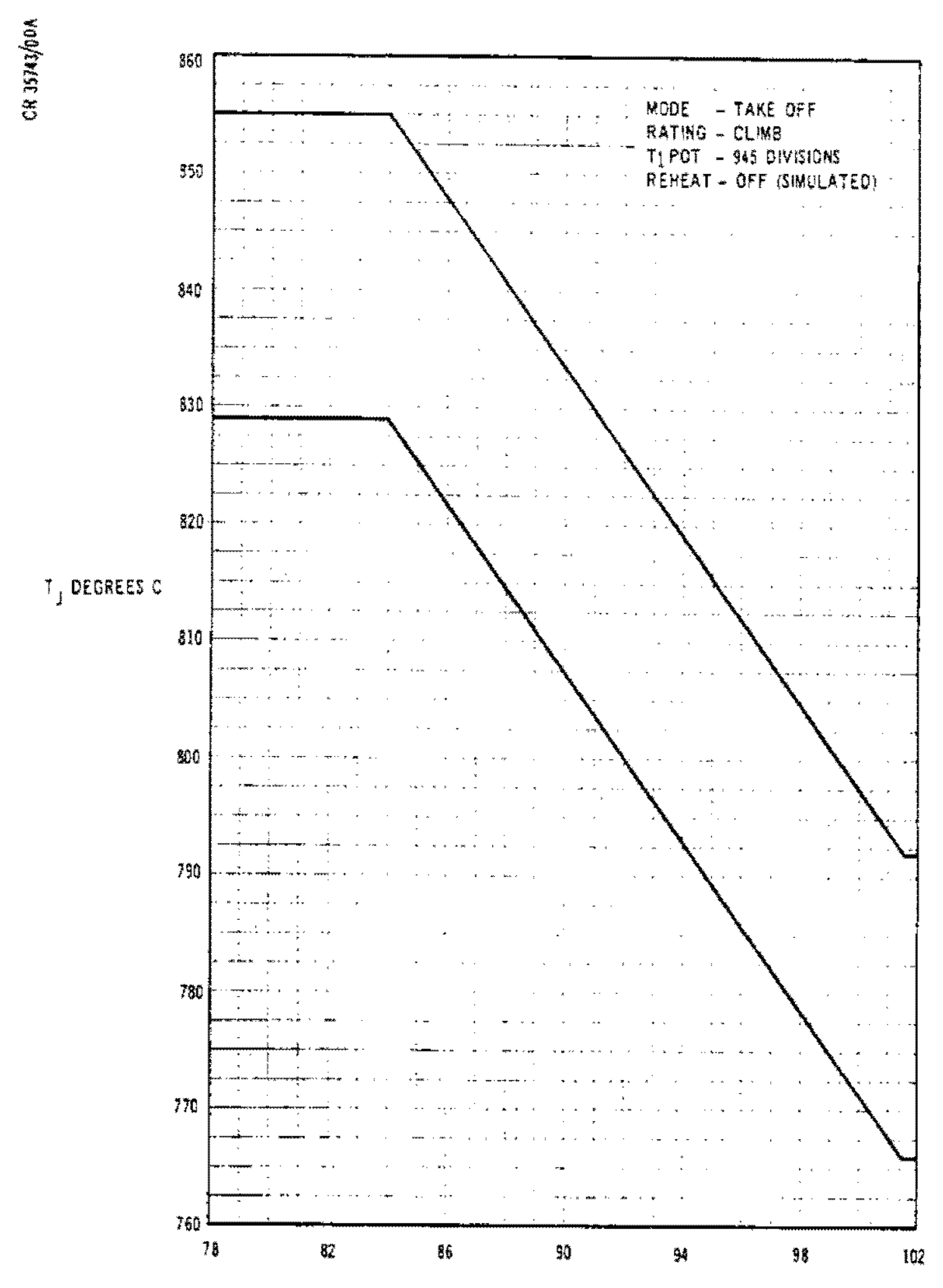
T_J DEGREES C

830
820
810
800
790
780
770
760
750
740

78 82 86 90 94 98 102

N_1%

EGT Limiter Datum - Amplifier A6A16/24CA, /24cc and /24DC with EGT Switch at Position 1
Figure 509



EGT Limiter Datum - Amplifier A6A16/24DC with EGT Switch at Position 2
Figure 510

CR 34044/008

MODE - TAKE OFF
RATING - CLIMB
T_1 POT - 378 DIVISIONS
REHEAT - OFF (SIMULATED)

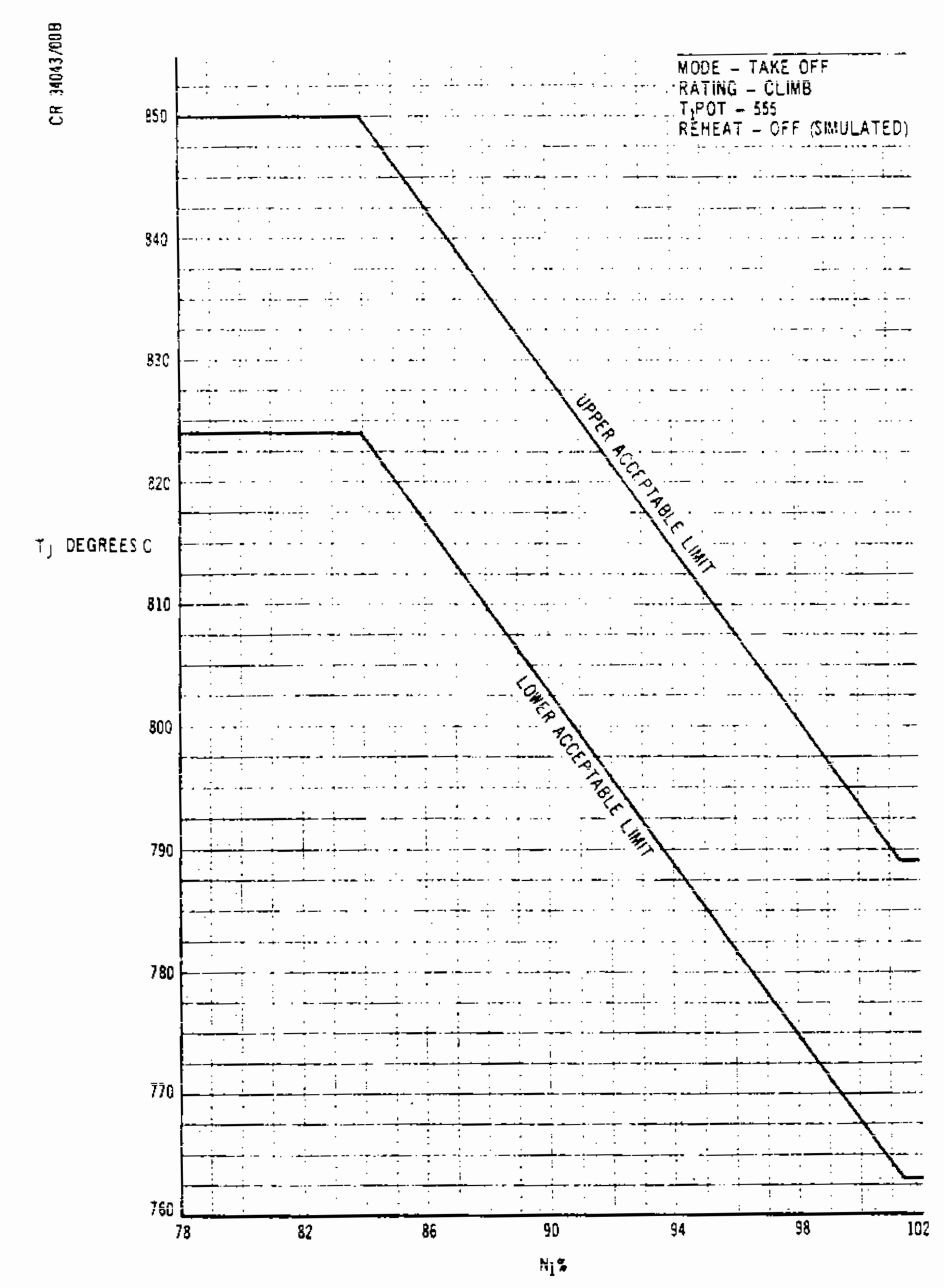
UPPER ACCEPTABLE LIMIT

LOWER ACCEPTABLE LIMIT

T_J DEGREES C: 750, 760, 770, 780, 790, 800, 810, 820, 830, 840

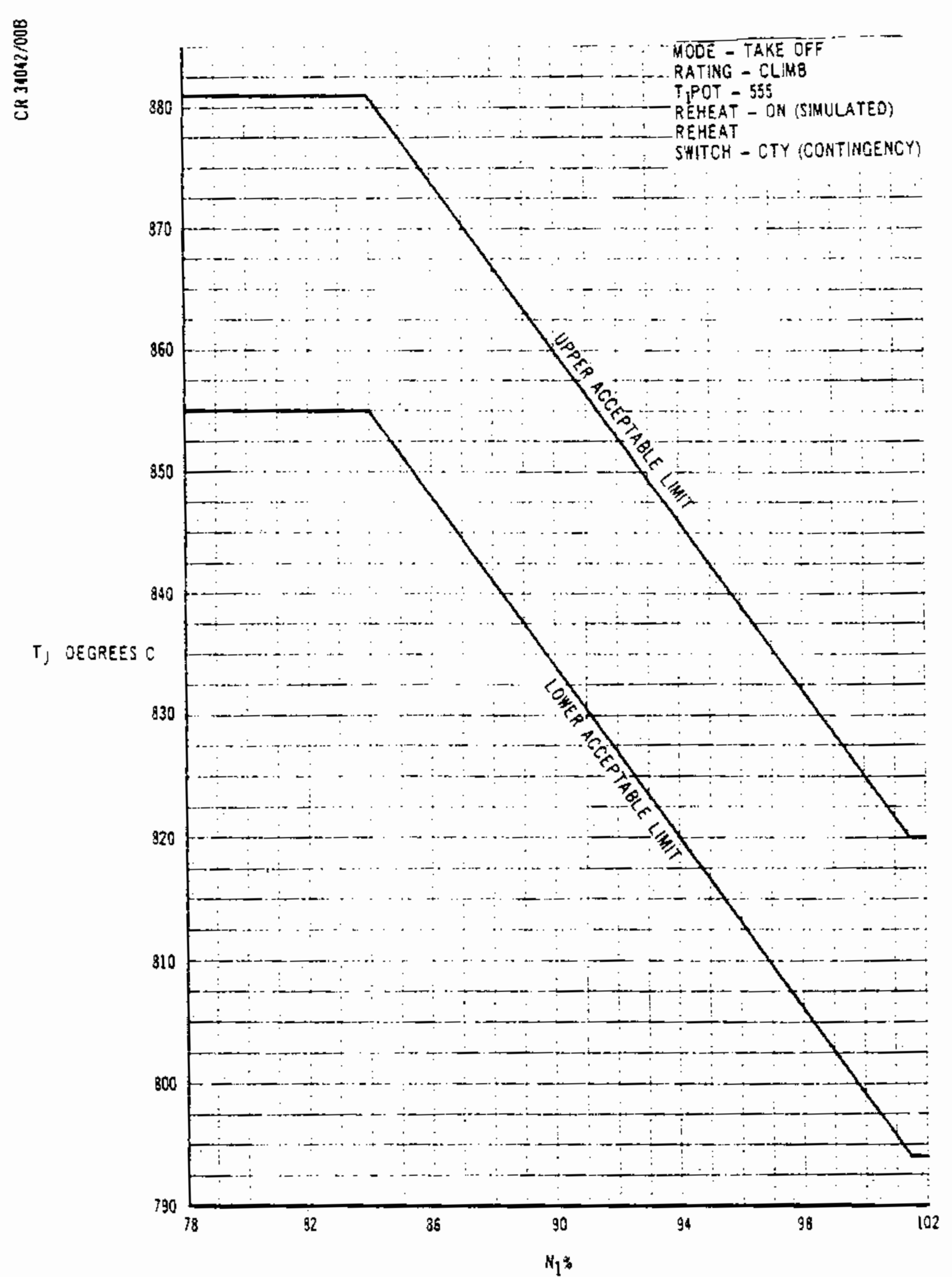
N_1%: 78, 82, 86, 90, 94, 98, 102

EGT Limiter Datum - T_1 Potentiometer 378 Divisions
Figure 511



EGT Limiter Datum - T_1 Potentiometer 555 Divisions
Figure 512

CR 34042/00B



EGT Limiter Datum - T_1 Potentiometer 555 Divisions - Contingency (CTY) Selected
Figure 513

(g) For type /24CA amplifiers only, select ENG RATING MODE to TAKE-OFF and T_1 potentiometer to 300 divisions. Set switch SW 3 to SIM and take reading.

Acceptable limit - N_2 - 4308 to 4350 Hz

(h) For type /24DC amplifiers with the EGT switch set at 2 only, set T_1 potentiometer to 945 divisions and switch SW 3 to T_J and take readings at the following ENG FLIGHT RATING settings and T alpha button operation.

RATING - T alpha Button - Acceptable Limit

CLIMB	- No	-	EGT - 687 to 7L3°C
CRUISE	- Press	-	EGT - 657 to 673°C

(j) Trip reheat circuit breakers, set EN switch up, T_1 potentiometer to 378 divisions and then continue with the checks of paragraph (5).

(5) Carry out N_1/root theta limiter and N_1 governor datum checks.

(a) Verify that cables are connected and switches set as specified in paragraph B and C (2) except that pilot's throttle lever is left at MAX.

(b) Record the frequency reading shown on test set meter.

Acceptable limit - 4109 to 4133 Hz

(c) Press and hold AICS button, record reading on test set % meter and release button.

Acceptable limit - 75% to 85%

(d) Set the T_1 potentiometer to 945 divisions and EN switch to the down position (simulates an engine control scehdule setting of HI) and record test set frequency reading.

Acceptable limit - 4200 to 4240 Hz

(e) With ENG FLIGHT RATING selector set to CLIMB, select FLIGHT on ENG RATING MODE selector. Set the RT switch down and record the test set frequency meter reading.

Acceptable limit - 4327 to 4369 Hz

(f) Reset ENG RATING MODE selector to TAKE-OFF.

(g) On No.4 engines only - set ENG No.4 T/O N_1 LIMITER switch to 88%. Record the frequency meter reading.

Acceptable limit - 3739 to 3759 Hz

(h) Make the following settings and then continue with the checks of paragraph (6).

(i) Pilot's lever - move to idle.

(ii) T/O N_1 LIMITER switch - set to NORM.

(iii) EN switch - set to up position.

(iv) T_1 potentiometer - set to 378 divisions

(6) Carry out engine control (E) schedule datum check.

(a) Verify that cables are connected and switches are set as specified in paragraph B and C (2).

(b) In each of the following checks, move the throttle lever until the checking value of N_2 registers on the flight compartment indicator (Ref. Fig.514) and then record the frequency readings for N_2 and N_1 shown on the test set meter. Set the N_2/N_1 selector to N_1 to obtain the N_1 reading and then reset selector to N_2. Check readings against the specified graph.

(i) At checking value 75% N_2 - use graph/ Fig.514.

(ii) At checking value 85% N_2 - use graph/ Fig.515.

(iii) At checking value 97% N_2 - use graph/ Fig.516.

(iv) Set EN switch down for remaining checks (v) to (x). This gives high engine control schedule condition.

(v) At checking value 84% N_2 - use graph/ Fig.517.

(vi) Set ENGINE CONTROL SCHEDULE selector to FLYOVER for this check, then reset to NORM.

At checking value 90% N_2 - use graph/ Fig.518.

(vii) At checking value 94% N_2 - use graph/ Fig.519.

(viii) At checking value 95% N_2 - use graph/ Fig.520.

(ix) Set T_1 potentiometer to 945 divisions for this check.

At checking value 100% N_2 - use graph/ Fig.521.

(c) Move pilot's throttle lever to idle and EN switch to the up position.

(d) Continue with the checks of paragraph (7).

(7) Carry out flame-out circuit operation, relight and P_1 datum checks.

(a) Verify that cables are connected and switches are set as specified in paragraph B and C (2).

CR 35744/00A

N_1 HZ

2550

2500

2450

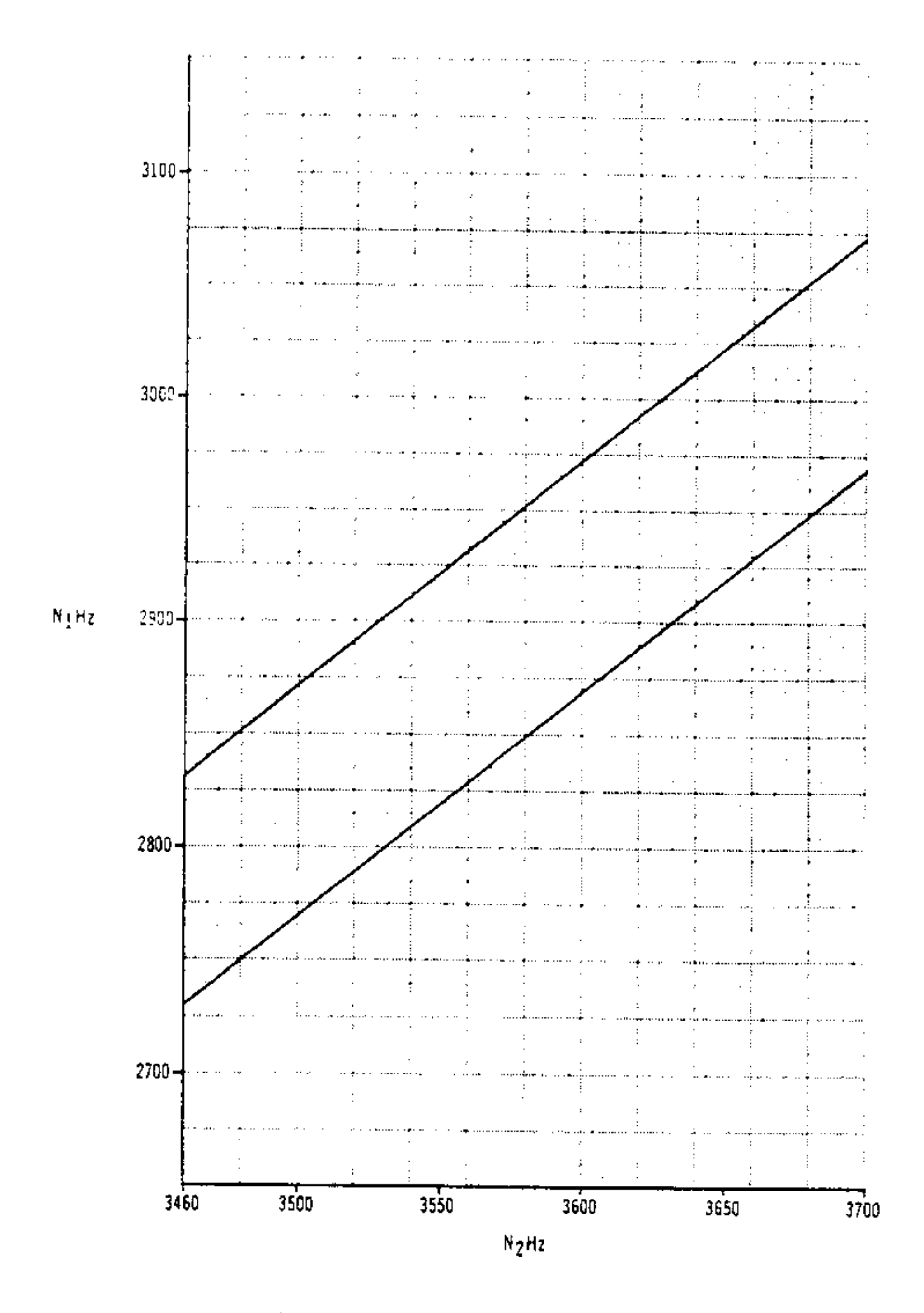
2400

3100 3150 3200

N_2 HZ

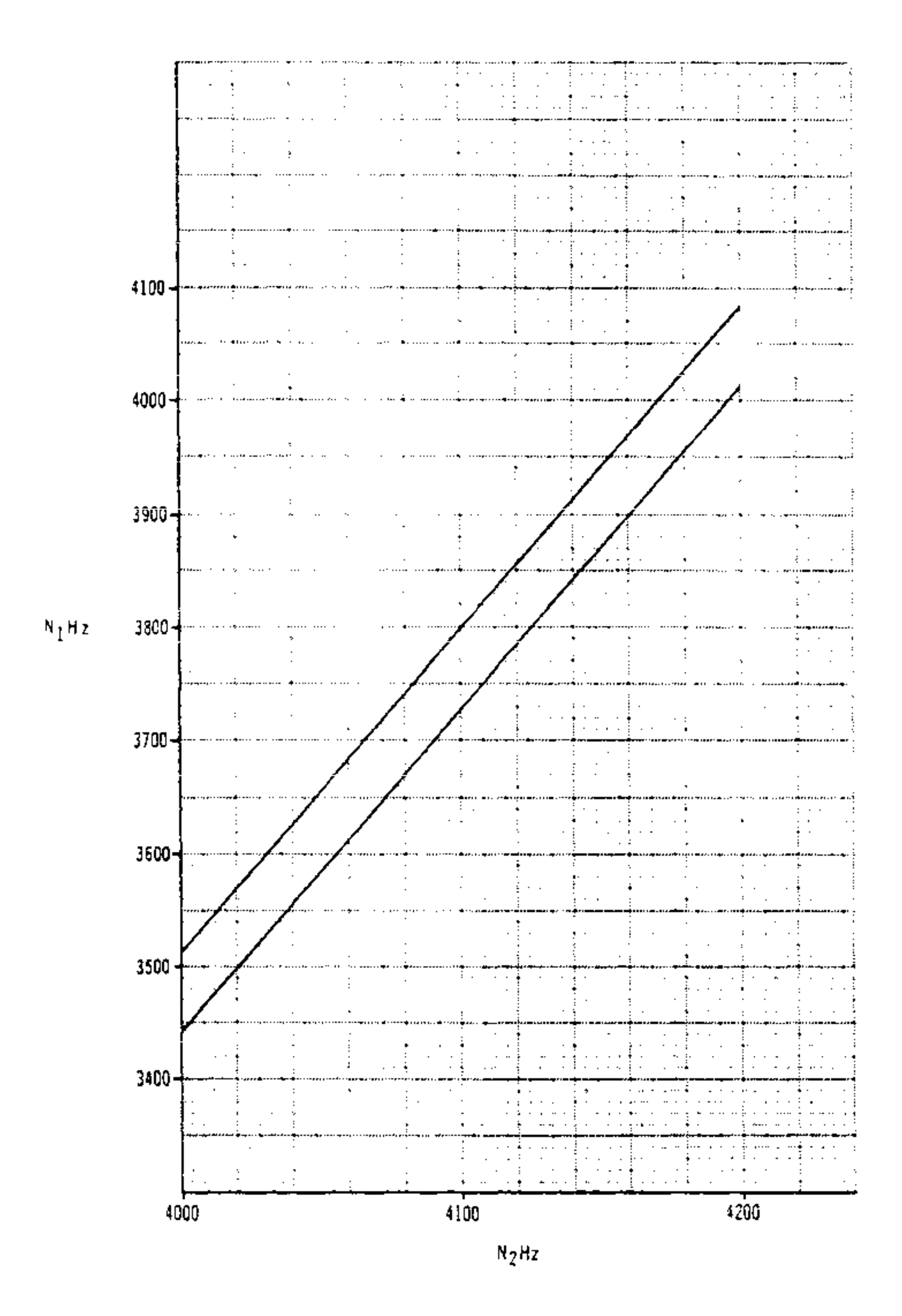
Engine Control (E) Schedule - N_2 75%
Figure 514

CR 35745/00A



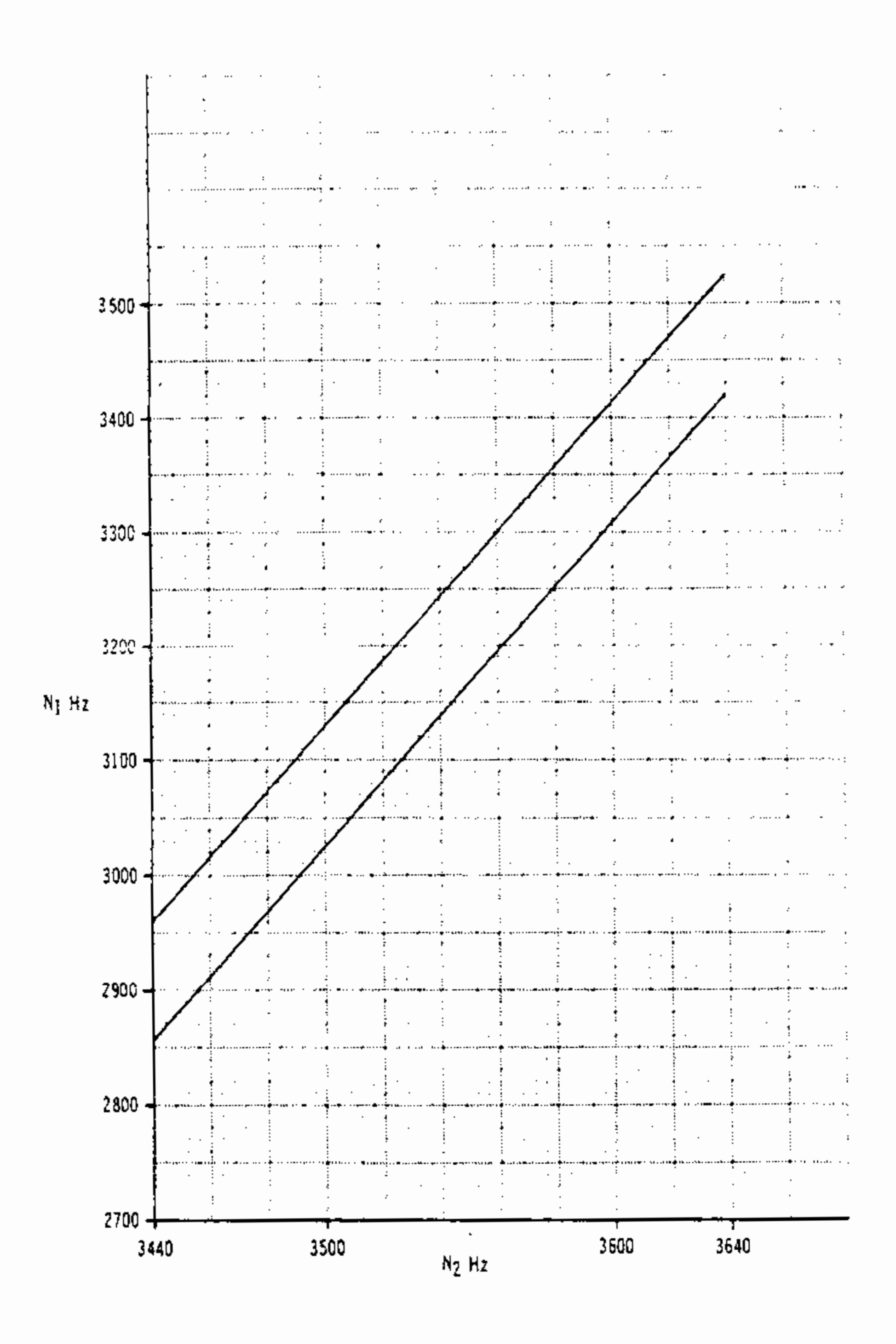
Engine Control (E) Scehdule - N_2 85%
Figure 515

CR 35746/D0A



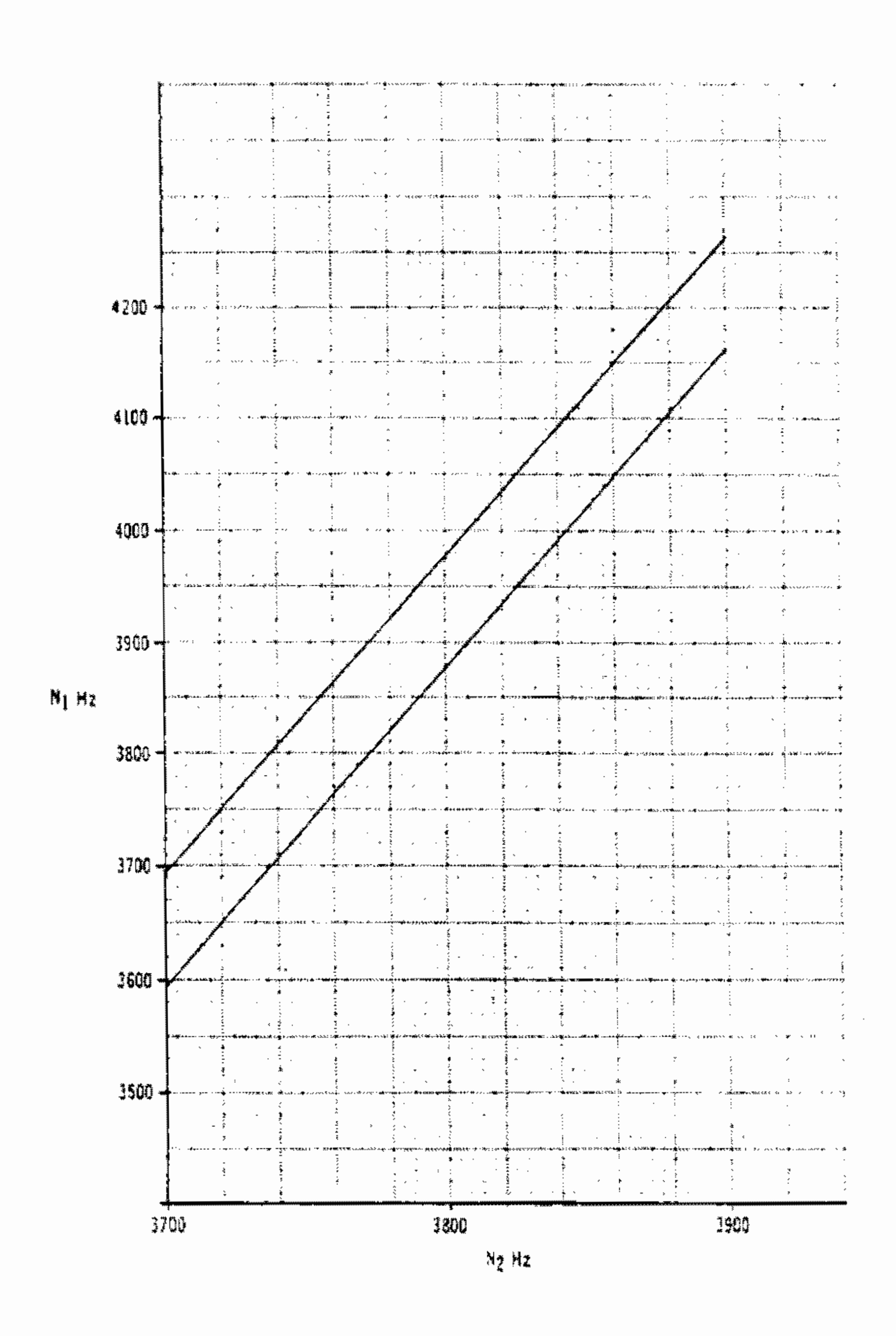
Engine Control (E) Schedule - N_2 97%
Figure 516

CR 35747/00A



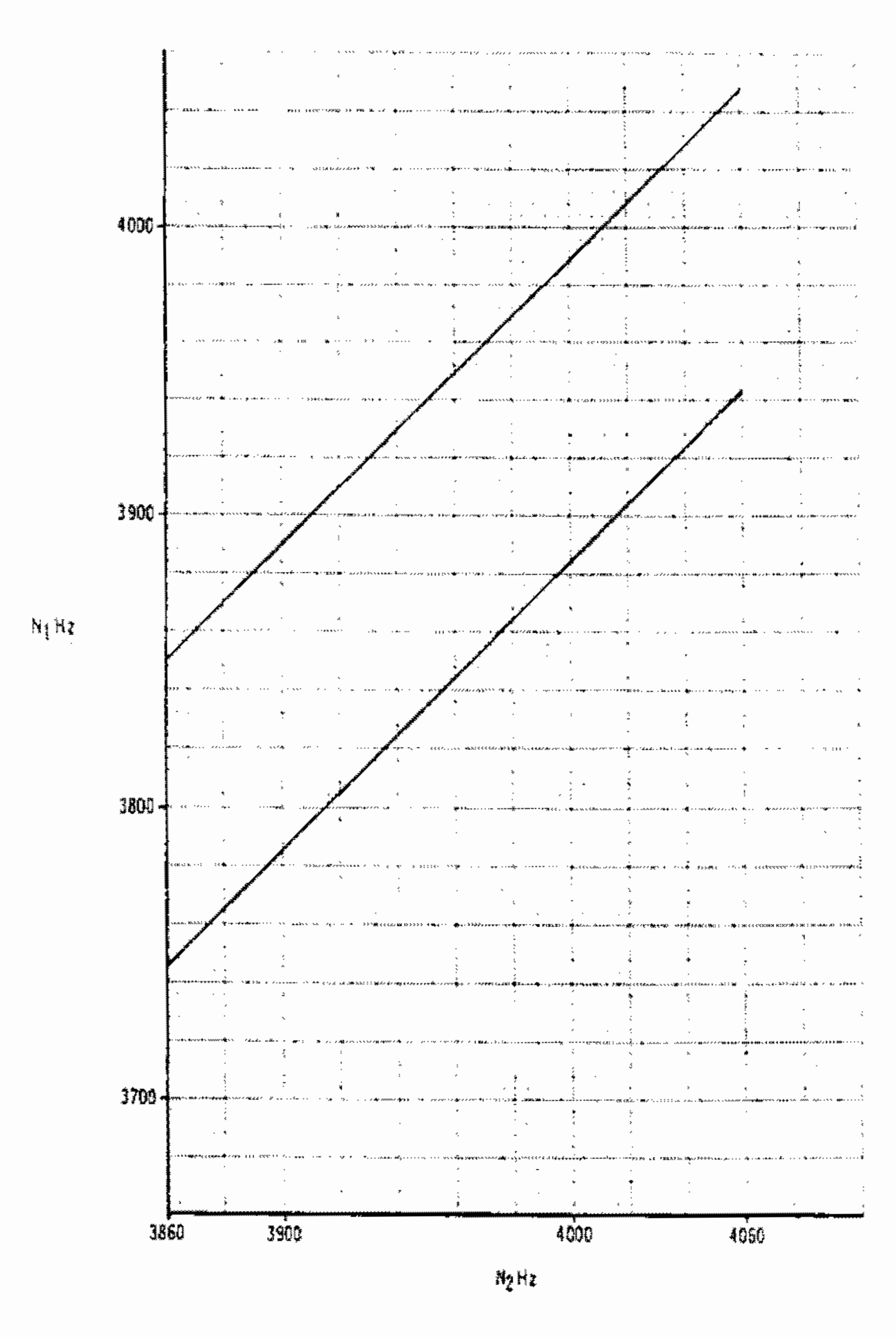
Engine Control (E) Schedule - N_2 84%
Figure 517

CR 35748/00A



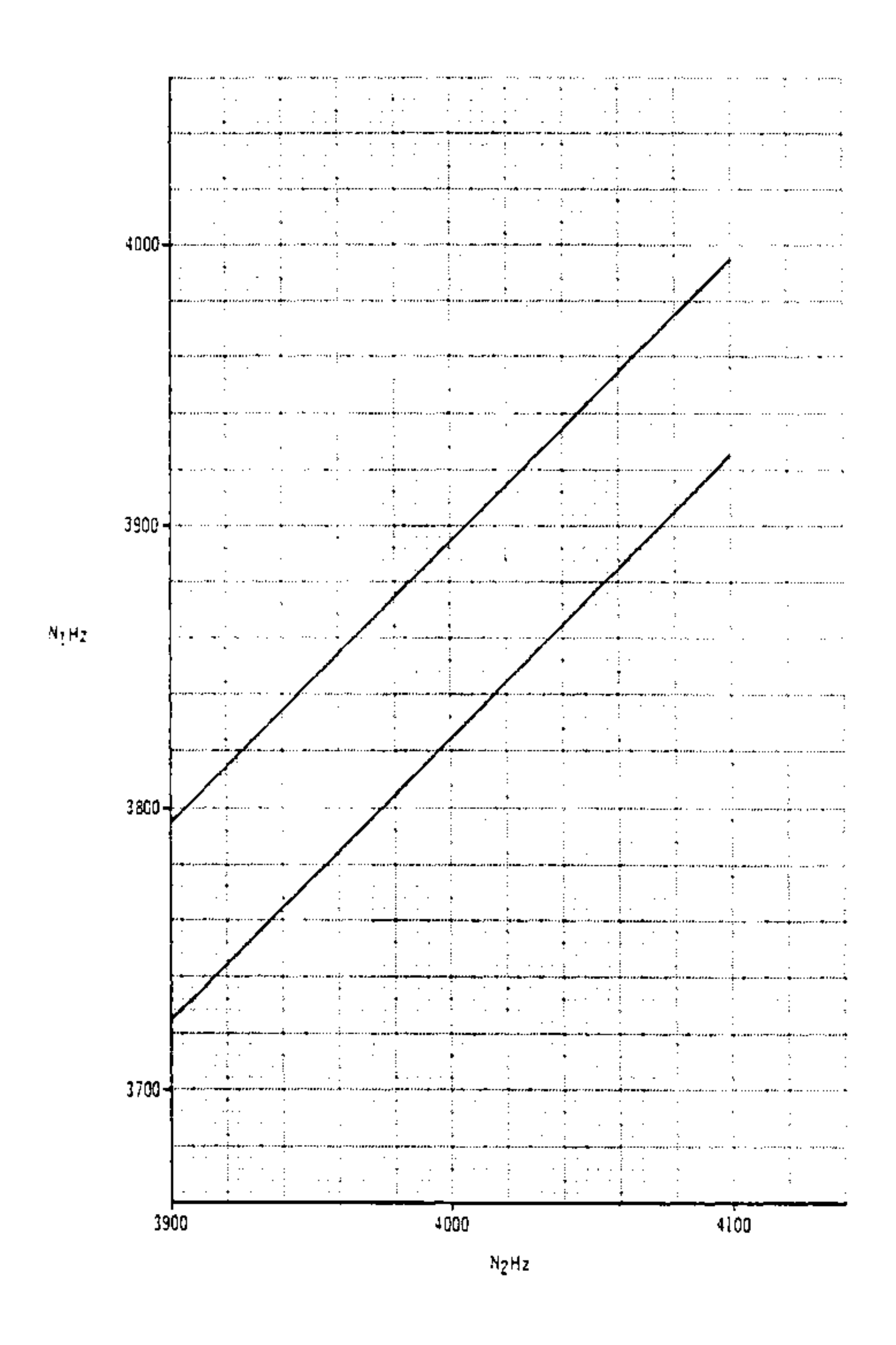
Engine Control (E) Schedule - N_2 90%
Figure 518

CR 35749/00A



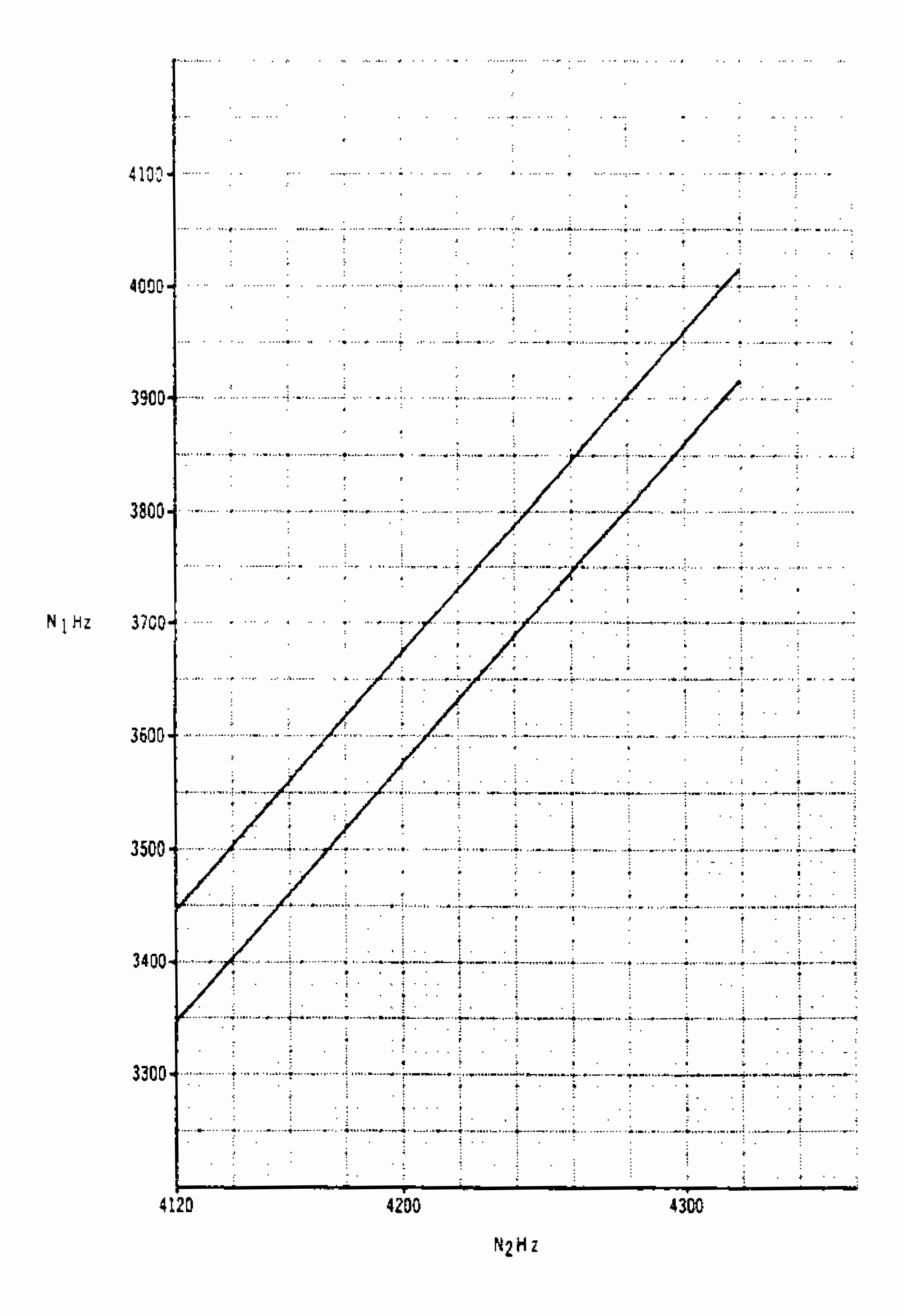
Engine Control (E) Schedule - N_2 94%
Figure 519

CR 35750/00A



Engine Control (E) Schedule - N_2 95%
Figure 520

CR 35751/00A



Engine Control (E) Schedule - N_2 100%
Figure 521

(b) Set switch 2 to position 5 and pilot's throttle lever to MAX.

(c) Ensure that ignition circuit breakers are tripped (Ref.Table 503) and set AUTO IGNITION switch to ON.

(d) Press and hold test set button FO, record % meter reading and release button.

Acceptable limit - minus 10 to plus 50%

(e) Set AUTO IGNITION switch to OFF while observing N_2 on the flight compartment indicator. N_2 should increase slowly to 67% and then, at a faster rate, to maximum.

(f) Set START/RELIGHT switch to RELIGHT and check that ignition captions are not illuminated. Move pilot's throttle lever slowly back to idle while observing ignition caption. Caption should illuminate when pilot's throttle lever reaches a point just above the idle position.

(g) Set the START/RELIGHT switch to OFF, pilot's throttle lever to MAX and T_1 potentiometer to 458 divisions.

(i) Record test set frequency reading as N_2 for comparison with the reading obtained in either paragraph (h) or in paragraph (j).

(h) Press and hold P_1 push-button and record test set stabilized frequency reading as N_2. Release button.

Satisfactory, if reading is 35 to 43 Hz less than reading obtained in paragraph (g),

(j) For type /24CA amplifiers, check as follows using a /24A test set. If this type test set is not available, use the fault locating test set and procedure (Ref. para.8) for this check.

(i) Set T_J O/C switch to down position.

(ii) Check that EGT failure warning indicator lamp illuminates.

(iii) Record test set frequency reading as N_2. Satisfactory, if reading is 16 to 24 Hz less than reading obtained in paragraph (g).

(iv) Set T_J O/C switch to up postion.

(k) Set pilot's throttle lever to idle and T_1 potentiometer to 378 divisions. Leave switch SW 2 at position 5 and continue with the checks in paragraph (8).

(8) Carry out debow and wind down checks.

(a) Verify that cables are connected and switches set as specified in paragraphs B and C (2), except for test set switch SW 2 retained in position 5.

(b) Set ENGINE DEBOW selector to DEBOW while observing N_2.

There should be no change of N_2 reading.

(c) Set T_1 potentiometer to 945 divisions for approximately 5 seconds and then reset potentiometer to 378 divisions. Record the stabilized test set frequency meter reading.

Acceptable limit - 1224 to 1480 Hz

(d) Set ENGINE DEBOW selector to NORMAL and move pilot's throttle lever to MAX.

(e) Select position B on NOZ AIR SOV & WIND DOWN TEST selector for the engine system under test, and record the reading on the test set percentage meter.

Acceptable limit - 0 to plus 50%

(f) Set WIND DOWN TEST selector to OFF, test set switch SW 2 to position 1 and T_1 potentiometer to 378 divisions.

(g) Leave pilot's throttle lever at MAX, and continue with the checks of paragraph (9).

(9) Carry out reverse thrust control check.

(a) Verify that cables are connected and switches set as specified in paragraphs B and C (2), except for pilot's throttle lever to be retained at MAX position.

(b) With N_2 stabilized at maximum conditions, set test set switch RT to down position and record percentage meter reading.

Acceptable limit - less than 10%

(c) Set test set switch RBD to down position, and record percentage meter reading and frequency meter reading.

Acceptable limit (%) - plus 75 to plus 85%
Acceptable limit (Hz) - 3788 to 3808 Hz

(d) Set test set switches RT and RBD to up position move pilot's throttle lever to idle and continue with checks of paragraph (10).

(10) Carry out the response time check.

(a) Verify that cables are connected and switches set as specified in paragraphs B and C (2).

(b) Ensure N_2 is stabilized and the throttle lever is at idle.

(c) Move the throttle lever rapidly to MAX and record time taken for N_2 on flight compartment indicator to reach 103%.

Acceptable time limit - less than 9 seconds

(d) Move pilot's throttle lever rapidly to idle and record time taken for test set meter indication to return within green band.

Acceptable time limit - less than 3 seconds

(e) If datum adjustments are to be done on the installed amplifier, comply with the procedure of paragraph 12, repeat the checks and continue with either paragraph (11) or (12).

(11) If any of the preceding checks (para.(3) to (10)) ar unsatisfactory, carry out the Function Lamp Check (Ref.para.E.) and ascertain whether the fault is within the amplifier or external to it in switches or wiring.

(12) If the preceding checks (Para.(3) to (10)) are satisfactory, carry out the Safety Systems Check (Ref.para.D.(3)) and then complete the procedure as detailed in paragraph F.

NOTE: The safety systems check is carried out as part of the amplifier post-installation procedure and also as an essential check when the throttle failure warning has been activated.

D. Checks After Throttle Failure Warning Light has Illuminated.

(1) General.

(a) If the fault identification module (FIM) facility is operative on either /24CC or /24DC type amplifiers, then checks are to be made in conjunction with the FIM procedures given in paragraph 13.

(b) The fault interrogation procedure is given in paragraph (2) and the safety system checks in paragraph (3).

(2) Carry out the fault interrogation tests.

(a) Ensure that the preparation procedure detailed in paragraph B is completed and continue with the preparation specific to this test.

(b) Remove flight plug, relevant plug and socket covers and connect cable 1 between the test set plug PL 1 and the amplifier socket SK 1 and reset the engine control circuit breakers (Ref. Table 504).

(c) Set the ENG RATING MODE selector to FLIGHT.

(d) Check that the position indicator lights register 30 and that the GO lamp is illuminated. If necessary, press the GO button to obtain the required setting.

<u>NOTE:</u> If lamp is not illuminated, check for lamp failure or supply distortion.

(e) Press the GO button and observe the test set response.

(i) Check that the GO lamp extinguishes and the test set runs through positions 1 to 30 with intermediate stops at positions 5, 10 and 13. Restart after a stop by pressing the GO button.

(ii) Check that GO lamp illuminates at final stop, position 30, to indicate a satisfactory check.

(iii) A fault will be disclosed if the test set stops at any other intermediate position with the GO lamp extinguished.

<u>NOTE:</u> Position 5 is allocated to turbine blade pyrometry and positions 10 and 13 are allocated to manual reset which are not incorporated.

(iv) Record the position of any indicated defect and restart the run.

(f) If a fault is detected, compare the indicated position at which the test stopped with Table 505 and determine the affected component system. The fault may be either in the aircraft wiring, or, in the system components external to the amplifier.

Position	Test	Fault Component or Interconnection
1	N_H Motor Control	Throttle Actuator
2	N_L Motor Control	Nozzle Trim Actuator
3	N_L Brake	Nozzle Trim Actuator
4	N_H Brake	Throttle Actuator
5	Turbine Blade Pyrometer	T.B.P. Amplifier
6	N_H V.F.B. Signal	Throttle Actuator
7	N_L V.F.B. Signal	Nozzle Trim Actuator
8	N_H P.F.B. Signal	Throttle Actuator
9	N_L P.F.B. Signal	Nozzle Trim Actuator
10	Manual Reset Signal	Manual Reset Transducer
11	Pilot Lever Pos. Signal	Pilots Lever
12	Pilots Lever Gov. Signal	Pilots Lever
13	Manual Reset Ref.	Manual Reset Transducer
14	Pilots Lever Ref.	Pilots Lever
15	N_H V and P.F.B. Ref.	Throttle Actuator
16	N_L V and P.F.B. Ref.	Nozzle Trim Actuator
17	N_H Pulse Probe	N_2 Pulse Probe
18	N_L Pulse Probe	N_1 Pulse Probe
19	T_1 Bulb	T_1 Bulb
20	N_H Motor Ref.	Throttle Actuator
21	N_L Motor Ref.	Nozzle Trim Actuator
22	T_J Thermocouple	T_J Thermocouple
23	T_1 Bulb 2	T_1 Bulb
24	Spare	
25	Spare	
26	Spare	
27	Spare	
28	Spare	
29	Spare	

Fault Interrogation
Table 505 (Concluded)

(g) Assess the defect, rectify it and repeat the test procedure. Final confirmation of a defective circuit or component may be achieved by conventional continuity testing.

(h) Set the ENG RATING MODE selector to TAKE OFF and either complete the test procedure as detailed in paragraph F., or continue with the next required check.

(3) Carry out the safety systems check.

(a) Ensure that the basic preparation procedure detailed in paragraph B. is completed and continue with the preparation specific to this test.

(b) Remove relevant covers and connect cable 2 between test set plug PL 2 and amplifier socket SK 2 and ensure the flight plug is installed in amplifier socket SK 1.

(c) Set the engine control circuit breakers (Ref. Table 504).

(d) Select THROTTLE MASTER switch to the amplifier to be tested (MAIN or ALTERN).

(e) Move pilot's throttle lever until 80% N_2 is indicated.

(f) Check that test set GO lamp is illuminated and position indicator lights register 30. Press GO button to advance indication to 30 if necessary.

NOTE: If lamp is not illuminated, check for lamp failure or supply distortion.

(g) When a test set is connected to a type /24CA amplifier press the GO button and observe for the following response:

(i) If a type /24A test set is used, check that the GO lamp extinguishes and the test set runs through positions 1 to 30 where the run stops and the GO lamp again illuminates to indicate a satisfactory check. Continue with paragraph (j).

(ii) If a /24B type test set is used, check that the GO lamp extinguishes and the test set runs through positions 1 to 30 with intermediate stops at positions 16 and 27. Restart after a stop by pressing the GO button, pressing twice at position 27. At the end of a satisfactory check the GO lamp again illuminates at position 30.

(iii) A fault is disclosed if the run stops at any other intermediate position than those stated. Carry out function lamp checks (Ref.para.E.).

(h) When a test set (/24B) is connected to a type /24CC or /24DC amplifier press the GO button and observe for the following response.

(i) Check that the GO lamp extinguishes and the test set runs through positions 1 to 27 where the run stops. Press the GO button twice to restart the run to position 30 where the run again stops and the GO light again illuminates.

(ii) A fault is disclosed if the run stops at any intermediate position other than 27. Carry out function lamp checks (Ref. para.E.).

(iii) If check is satisfactory, continue with paragraph (j).

(j) On completion of the test set run, check that the throttle failure warning light is illuminated and select the THROTTLE MASTER switch off.

(k) Check that the throttle failure warning light is illuminated and select the THROTTLE MASTER switch to OFF and then reselect the amplifier under test (MAIN or ALTERN).

(i) For a satisfactory check, the GO lamp remains illuminated and the throttle failure warning extinguishes.

(ii) If the check is not satisfactory, carry out the function lamp checks (Ref. para.E.).

(l) On type /24CC and /24DC amplifiers with an operative FIM, press the reset button and check that all indicator code lights illuminate, then release the button and check that the indicators extinguish. If any indicators remain illuminated, a defect exists and should be checked as detailed in paragraph 13.

(m) Set pilot's throttle lever to idle and, either complete the test procedure as detailed in paragraph F., or, continue with the next required check.

E. Function Lamp Checks.

(1) General.

(a) The function lamp checks are required when the results of the checks given in paragraphs C. and D.(3) were unsatisfactory.

(b) The checks of this section will determine if the switches and associated wiring to the amplifier are satisfactory. A satisfactory check indicates that the fault is associated with the amplifier.

(2) Ensure that the basic preparation procedure detailed in paragraph B. is completed and continue with the preparation specific to this test.

(a) Connect cable 1 between test set plug PL 1 and amplifier socket SK 1 and reset engine control circuit breakers (Ref. Table 504).

(b) Set reheat circuit breakers (Ref.Table 503).

(c) In turn, select the following flight compartment switch settings, check for illumination of the stated test set lamp and reselect switch to its original setting (Ref.Table 506).

SWITCH		SETTING		INDICATOR ILLUMINATED
ENGINE DEBOW	-	DEBOW	-	D/B
Reheat circuit breakers	-	trip	-	R/H
WIND DOWN TEST	-	B	-	RB
AUTO IGNITION	-	ON	-	A1 and C1
THROTTLE MASTER (MAIN/ALTERN)	-	to amplifier under test	-	DC

Switch/Lamp Checks
Table 506

(3) If no further checks are required, complete the procedure as detailed in paragraph F.

F. Complete the Test Procedure if no Further Tests Required.

(1) Reset the test set and flight compartment switches to normal settings.

(2) Disconnect the test set from the amplifier.

(a) Trip the engine control circuit breakers (Ref. Table 504).

(b) Disconnect and remove test set cables and install flight plug in amplifier socket SK 1 and install remaining plug and socket covers in their respective positions.

(3) Verify work is completed, remove safety clips and reset the circuit breakers listed in Tables 503 and 504.

(4) Check flight plug installation for satisfactory operation.

(a) Select THROTTLE MASTER switch to the amplifier to be checked (MAIN or ALTERN).

(b) Check that the throttle failure warning light remains extinguished.

(c) Select THROTTLE MASTER switch to OFF.

(5) On amplifiers with an operative FIM facility, press the reset button, check that the four indicators illuminate, release the button and check that the four indicators extinguish. If any lights remain illuminated, a defect exists and should be checked as detailed in paragraph 13.

11. Checks After Installation or Adjustment of Control System Components

A. General.

The following components require a check using a test set after installation or adjustment. The complete checking procedure is not necessary and the checks applicable to specific components are defined in this paragraph.

Each of the specified checks must be carried out on both MAIN and ALTERN amplifiers.

Post-installation procedure and references are given for the following components:

Engine Control Amplifier (para.B.)
Actuator Gearbox (TV) (para.C.)
Pilot's Throttle Control Transmitter and Related Adjustments (para.D.)
P.N.C. Trim Unit (para.E.)
LP Compressor RPM Probe (N_1) (76-12-01, Adjustment/Test)
HP Compressor RPM Probe (N_2) (76-12-02, Adjustment/Test)
T_1 Temperature Probe (para.F.)
Jet Pipe Thermocouple Harness (T_J) (para.G.).

B. Engine Control Amplifier Checks.

(1) A reduced check can be carried out without the test set.

(a) With engine control circuit breakers set, select THROTTLE MASTER switch to the amplifier to be checked.

(b) Check that the throttle failure warning does not illuminate. Set switch to OFF.

(c) On amplifiers with the FIM facility operative, check that the FIM indicators are not illuminated If illuminated, press the reset button and check that the indicators illuminate and then extinguish when the button is released. If any lights remain illuminated, a defect exists and should be checked as detailed in paragraph 13.

(2) If a full check of an amplifier is considered necessary, carry out the procedure given in paragraph 10.C.

C. Actuator Gearbox (TV) Checks.

(1) Carry out the checks specified for the Idle Governor and Positioner Datum Checks (Ref.para.10.C.) on both MAIN and ALTERN amplifiers.

D. Pilot's Throttle Control Transmitter Installation and Related Adjustments Checks.

(1) Trip the circuit breaker listed in Tables 503 and 504.

(2) Make the following flight compartment switch selections:

ENG FLIGHT RATING	-	CLIMB
ENG RATING MODE	-	TAKE-OFF
ENGINE CONTROL SCHEDULE	-	NORMAL and LO
GRD IDLE	-	HI
ENG 4 T/O N_1 LIM	-	NORM
START/RELIGHT	-	OFF
AUTO IGNITION	-	OFF
Ignition selector	-	OFF
Pilot's throttle lever	-	IDLE

(3) Make the following test set switch selections:

SW 1	-	position 1
SW 2	-	position 2
SW 3	-	SIM
N_2/N_1	-	N_2
Remainder	-	set to up position

(4) Connect cable 1 between test set plug PL 1 and amplifier socket SK 1 and reset engine control circuit breakers (Ref.Table 504).

(5) Set the THROTTLE MASTER switch to the amplifier connected for test (MAIN or ALTERN).

(6) Record the percentage meter reading.

Acceptable limit - minus 10% to plus 10%

(7) Set switch 2 to position 3 and record the meter reading.

Acceptable limit - full scale positive

(8) Set pilot's throttle lever to MAX and record the percentage meter reading.

Acceptable limit - minus 10% to plus 10%

(9) Set switch 2 to position 2 and record the percentage meter reading.

Acceptable limit - full scale positive

(10) Set the THROTTLE MASTER switch OFF and repeat the procedure with the other amplifier connected.

(11) On completion of satisfactory checks, complete the procedure.

(a) Set pilot's throttle lever to idle.

(b) Trip the engine control system circuit breakers (Ref.Table 504).

(c) Disconnect the cable from the test set and amplifier, install flight plug in both amplifiers socket SK 1 and plug and socket covers on test set.

(d) Reset engine control circuit breakers, select THROTTLE MASTER switch to the amplifier with the re-installed flight plug and check that the throttle failure warning does not illuminate.

(e) On amplifiers with the FIM facility operative, check that the FIM indicators are not illuminated If illuminated, press the reset button and check that indicators extinguish when button is released (Ref.para.13.).

(12) Set the THROTTLE MASTER switch to OFF.

(13) Ensure that flight compartment switches are at the normal settings and reset the circuit breakers listed in Table 503.

E. P.N.C. Trim Unit Check.

(1) Prepare for the check as detailed in paragraph 10.B.

(2) Remove the plugs and covers and connect the cables.

(a) Connect cable 2 between test set plug PL 2 and amplifier socket SK 2.

(b) Connect cable 3 between test set plug PL 3 and amplifier socket SK 1.

(c) Reset engine control circuit breakers (Ref. Table 504).

(3) Set T_1 potentiometer to 378 divisions.

(4) Set THROTTLE MASTER switch to the amplifier (MAIN or ALTERN) connected to the test set.

(5) Set pilots throttle lever to MAX position.

(6) Record reading shown on test set frequency meter as N_1.

Acceptable limit - 4109 to 4133 Hz

(7) Set the pilots throttle lever to idle and the THROTTLE MASTER switch to OFF and repeat the procedure with the other amplifier connected.

(8) After an acceptable check, complete the procedure.

(a) Return pilots throttle lever to idle.

(b) Select the THROTTLE MASTER to OFF and trip the engine control circuit breakers (Ref. Table 504).

(c) Disconnect the cables from the test set and amplifier, install flight plug in amplifier socket SK 1 and plug and socket covers on amplifier socket SK 2 and test set connectors.

(d) Reset the engine control circuit breakers, select THROTTLE MASTER switch to the amplifier with the re-installed flight plug and check that the throttle failure warning does not illuminate.

(e) On amplifiers with the FIM facility operative, check that the FIM indicators are not illuminated. If illuminated, press the reset button and check that indicators extinguish when button is released (Ref.para.13).

(f) Ensure that flight compartment switches are at the normal settings and reset the circuit breakers listed in Table 503.

F. T_1 Temperature Probe Check.

<u>NOTE:</u> One of the two lanes in a T_1 probe connects to the MAIN amplifier for the engine where it is installed. The second lane of a probe cross connects to the ALTERN amplifier of the adjacent engine (engine 1 with engine 2 and engine 3 with engine 4).

(1) Ensure that flight compartment switches are at normal settings and circuit breakers are reset.

(2) Select MAIN on the THROTTLE MASTER switch of the engine/T_1 probe under test and check that the throttle failure warning is not activated. Set switch to OFF.

(3) Select ALTERN on the THROTTLE MASTER switch of the adjacent engine to the engine under test and check that the throttle failure warning is not activated. Set switch to OFF.

(4) On amplifiers with the FIM facility operative, check that the indicators are not illuminated. Refer to paragraph 13. for procedures.

G. Jet Pipe Thermocouple Harness Checks

(1) Ensure that flight compartment switches are at the normal settings and circuit breakers are reset.

(2) Select the THROTTLE MASTER switch to MAIN and check that the throttle failure warning is not activated. Check that yellow failure warning of EGT indicator does not illuminate.

(3) Select the THROTTLE MASTER switch to ALTERN and repeat the checks.

(4) Set THROTTLE MASTER switch OFF.

12. Installed Amplifier Datum Setting Checks/Adjustment (Ref.Fig.522)

A. General.

Adjustment procedures are given in this paragraph for the following datums:

Idle Governor
N_2 Limiter
EGT Limiter
N_1 Root Theta Limiter
N_1 Governor
Flame-out Circuit Operation
Maximum Reverse Thrust.

These are the only permissible datum adjustments that may be carried out on an installed amplifier. The full datum checking procedure is given in paragraph 10.C.

CAUTION: DO NOT ADJUST ANY POTENTIOMETERS EXCEPT THOSE DETAILED. DO NOT ALTER EGT SWITCH SETTING DURING ADJUSTMENT PROCEDURES.

Potentiometers located in the front panel of the amplifier provide for the adjustment of the various datum settings. Each potentiometer is numbered and the adjustment procedure detailed in this paragraph is common to all the potentiometers.

B. Basic Procedure for Checks.

(1) If a distorted electrical supply is indicated by illumination of the DS lamp, do not continue with the check/adjustment until the fault is rectified.

(2) Trip the circuit breakers indicated in Tables 503 and 504. Attach safety clips.

(3) Connect the cables between the test set and amplifier.

(a) Connect cable 2 between test set plug PL 2 and amplifier socket SK 2.

(b) Connect cable 3 between test set plug PL 3 and amplifier socket SK 1.

(c) Reset the engine control system circuit breakers (Ref.Table 504).

(4) Make the following flight compartment switch selections:

ENG FLIGHT RATING	-	CLIMB
ENG RATING MODE	-	TAKE-OFF
ENGINE CONTROL SCEHDULE	-	NORMAL and LO
GRD IDLE	-	HI
ENG 4 T/O N_1 LIM	-	NORM
START/RELIGHT	-	OFF
AUTO IGNITION	-	OFF
Ignition selector	-	OFF
THROTTLE MASTER	-	OFF
Pilot's throttle lever	-	IDLE

(5) Make the following test set switch selections:

SW 1	-	position 1
SW 2	-	position 1
SW 3	-	SIM
N_2/N_1	-	N_2
Remainder	-	set to up position

C. Idle Governor Datum Checks.

(1) Carry out basic procedure and switch settings detailed in paragraph B.

(2) Make the following flight compartment and test set switch selections specific to this check.

(a) Set THROTTLE MASTER switch to amplifier connected for check (MAIN or ALTERN),

(b) Set SW 2 to position 5.

(c) Set T_1 pot to 479 divisions.

(3) Note stabilized N_2 frequency reading shown on the test set frequency meter and compare it with the stated limit.

Acceptable limit - 2815 to 2858 Hz

If necessary, use the procedure detailed in paragraph (4) and adjust potentiometer No.12 until the reading is within the stated limit.

(4) Adjust potentiometer and obtain an acceptable datum value (Ref.Fig.522).

(a) Note the EGT switch setting (/24DC amplifiers).

(b) Unscrew the two knurled-headed screws securing the hinged potentiometer cover to the amplifier front panel and open cover.

(c) Locate the potentiometer to be adjusted by reference to the data plate on the cover.

<u>CAUTION:</u> DO NOT USE EXCESSIVE FORCE WHEN ADJUSTING A POTENTIOMETER.

(d) Using a small bladed screwdriver, and while watching the relevant test set meter, screw the potentiometer either clockwise or counter-clockwise until an acceptable datum value is achieved.

Record the number of clockwise or counter-clockwise turns applied to the potentiometer, so that, should the wrong potentiometer be turned, it can be returned to its original setting.

(e) On satisfactory completion of all adjustments, ensure that the EGT switch (/24DC amplifiers) is in the original setting (Ref.para.(a)) and close the cover. Secure cover with two knurled-headed screws and wire-lock screws.

(5) Select flight compartment GRD IDLE switch to LO and note stabilized N_2 frequency reading shown on the test set meter. Compare the reading with the limit given.

Acceptable limit - 2815 to 2858 Hz

If necessary, use the procedure detailed in paragraph (4) and adjust potentiometer No.20 until the reading is within the stated limit.

(6) On satisfactory completion of checks, return flight compartment and test set switches to their original settings (Ref.para.B.).

(7) If no further checks are required, complete the test procedure detailed in paragraph J.

D. N_2 Limiter Datum Checks.

(1) Carry out basic procedure and switch settings detailed in paragraph B.

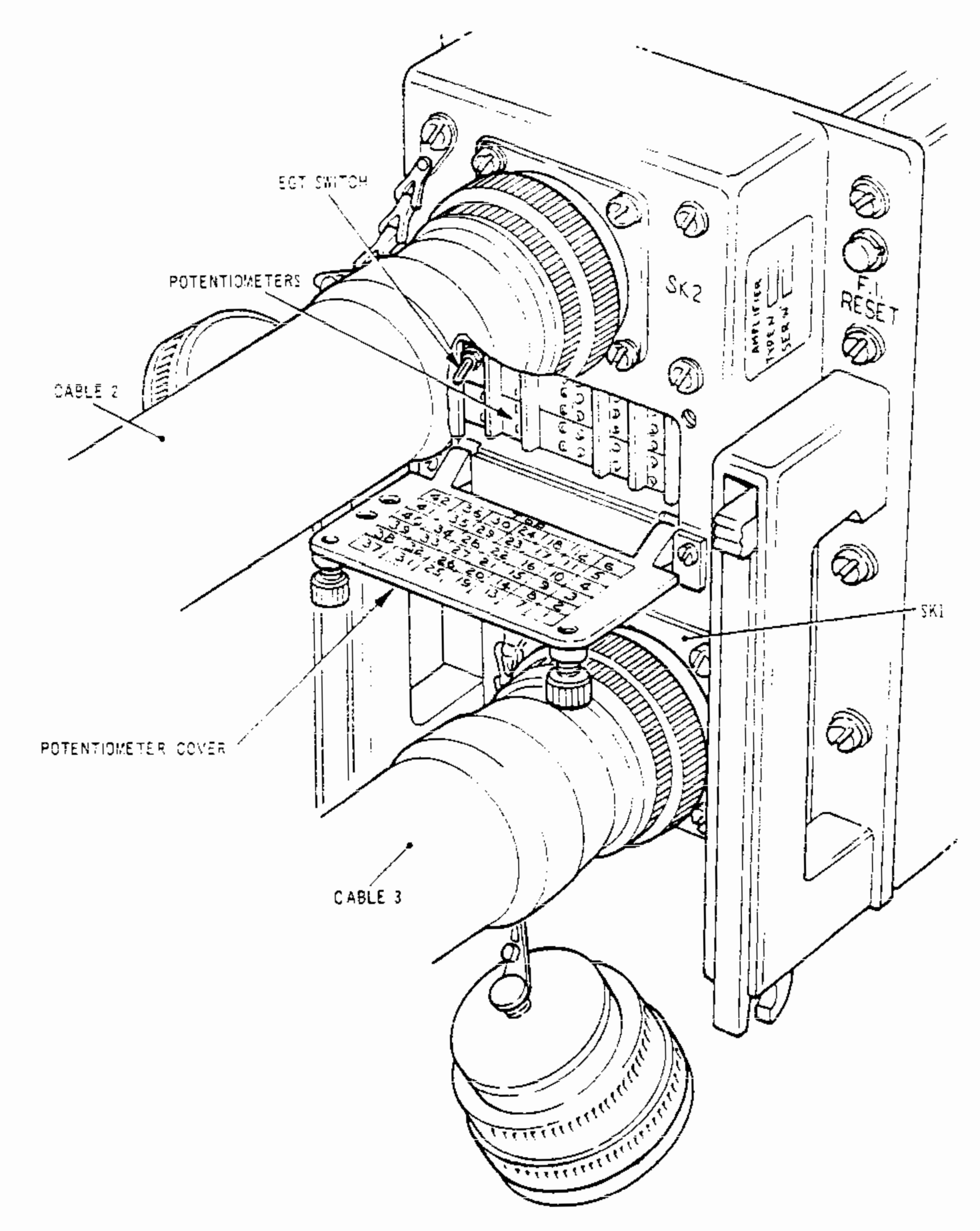
(2) Set the reheat circuit breakers (Ref.Table 503) and make the following flight compartment selections specific to this test.

Pilots throttle lever	-	MAX
THROTTLE MASTER	-	to amplifier connected for check (MAIN OR ALTERN)
ENG 4 T/O N_1 LIMITER	-	NORM

(3) Set the test set T_1 pot to each of the following positions in turn and note the stabilized N_2 frequency reading, shown on the test set frequency meter, for each position,

378 divisions	-	Acceptable limit 4394 to 4414 Hz
555 divisions	-	Acceptable limit 4423 to 4443 Hz
945 divisions	-	Acceptable limit 4472 to 4492 Hz

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Amplifier Datum Setting Adjustment Details
Figure 522

If necessary, adjust potentiometer No.3 (Ref.para.C.(4)) until all the readings are within their stated limits.

NOTE: Adjustment of No.3 potentiometer affects all three readings.

(4) Trip the REHEAT CONT circuit breaker (Ref.Table 503) to simulate reheat on and make the following switch selections.

Flight compartment REHEAT SELECTOR	-	CTY
Test set T_1 pot setting	-	555 divisions

Note the stabilized N_2 frequency reading shown on the test set frequency meter and compare it with limit given.

Acceptable limit - 4476 to 4496 Hz

If necessary, adjust potentiometer No.2 (Ref.para.C.(4)) until the reading is within the stated limit.

(5) Make the following flight compartment switch selections.

REHEAT selector	-	OFF
ENGINE RATING MODE	-	FLIGHT

Note the N_2 frequency reading shown on the test set frequency meter. Compare the reading with the limit given.

Acceptable limit - 4375 to 4395 Hz

If necessary, adjust potentiometer No.6 (Ref.para.C.(4)) until the reading is within the stated limit.

(6) Set the reheat circuit breakers (Ref.Table 503), to simulate reheat off, and make the following flight compartment switch selection.

ENG FLIGHT RATING - CRUISE

Note the stabilized N_2 frequency reading shown on the test set frequency meter and compare it with the limit given.

Acceptable limit - 4362 to 4382 Hz

If necessary, adjust potentiometer No.5 (Ref.para.C.(4)) until the reading is within the stated limit.

After adjustment of potentiometer No.5, carry out the procedures detailed in paragraphs (5) and (7).

NOTE: Adjustment of No.5 potentiometer affects the datums governed by potentiometers No.4 and No.6

(7) Press and hold the test set T alpha button, record the stabilized N_2 frequency reading shown on the test set meter and release button. Compare the reading with the limit given.

Acceptable limit - 4309 to 4329 Hz

If necessary, adjust potentiometer No.4 (Ref.para.C.(4)) until the reading is within the stated limit.

(8) On satisfactory completion of checks, return flight compartment and test set switches to their original settings (Ref.para.B.).

(9) If no further checks are required, complete the test procedure detailed in paragraph J.

E. EGT Limiter Datum Checks (Ref.Figs.508, 509, 510, 511, 512 and 513).

(1) Carry out basic procedure and switch settings detailed in paragraph B. and continue with the check in strict sequence, paragraphs (2) to (7).

(2) Make the following flight compartment and test set switch selection specific to this check.

Flight compartment selections:

Pilots throttle lever	-	MAX
THROTTLE MASTER	-	to amplifier connected for check (MAIN OR ALTERN)
ENG 4 T/O N_1 LIMITER	-	NORM

Test set selection:

SW 3 - T_J

NOTE: With test set switch 3 selected to T_J and N_1/N_2 switch to N_2 the test set digital display frequency meter reading will be in deg C.

(3) Set the test set T_1 pot to each of the following positions in turn and note the stabilized EGT reading, shown on the test set frequency meter, and the N_1 speed, shown on the flight compartment LP RPM indicator, for each position. Apply the EGT/N_1 values for each position to the graph of the specified Figure. For a satisfactory test the readings must be within the acceptance band,

378 divisions	-	Acceptable limit see Figure 511
555 divisions	-	Acceptable limit see Figure 512
945 divisions	-	Acceptable limit for amplifier types: /24CA, /24CC and /24DC with EGT switch at position 1, see Figure 509. /24DC with EGT switch at position 2, see Figure 510.

If necessary, adjust potentiometer No,26 (Ref.para.C.(4)) until all the readings are within their acceptance band.

NOTE: Adjustment of No.26 potentiometer affects all three readings.

(4) Trip the REHEAT CONT circuit breaker (Ref.Table 503), to simulate reheat on, and make the following switch selections.

Flight compartment REHEAT SELECTOR	-	CTY
Test set T_1 pot	-	555 divisions

Record the stabilized EGT reading, shown on the test set frequency meter, and the N_1 speed, shown on the flight compartment LP RPM gauge. Apply the EGT/N_1 values obtained to the graph of Figure 513. For a satisfactory test the reading must be within the acceptance band.

If necessary, adjust potentiometer No.25 (Ref.para.C.(4)) until the reading is within the acceptance band.

(5) Make the following flight compartment switch selections.

REHEAT selector	-	OFF
ENG RATING MODE	-	FLIGHT

Note the EGT reading shown on the test set frequency meter. Compare the reading with the limit given.

Acceptable limit - 708 to 734 deg C

If necessary, use the procedure detailed in paragraph C.(4) and adjust potentiometer No.29 until the reading is within the stated limit.

(6) Set the reheat circuit breakers (Ref.Table 503), to simulate reheat off, and carry out the procedure detailed in paragraph (a) on all standards of amplifier and the additional check procedure given in paragraph (b), on type /24DC amplifiers with the EGT switch retained in position 2.

(a) Set the ENG FLIGHT RATING switch to CRUISE and note the stabilized EGT reading, shown on the test set frequency meter, and compare it with the limit given.

Acceptable limit - 690 to 716 deg C

On amplifiers type /24CA, /24CC and /24DC with EGT switch in position 1, adjust potentiometer No.28 (Ref.para.C.(4)) until the reading is within the acceptable limit. On an amplifier type /24DC with EGT switch in position 2, record the reading and use in conjunction with the reading obtained in paragraph (b).

After adjustment of potentiometer No.28, carry out the procedures detailed in paragraphs (5) and (7).

NOTE: Adjustment of No.28 potentiometer affects the datums governed by potentiometers No.27 and No.29.

(b) On an amplifier type /24DC with EGT switch retained in position 2, make the following switch settings for the additional check.

T_1 potentiometer - 945 divisions
ENG FLIGHT RATING - CLIMB

Note the stabilized EGT reading shown on the test set frequency meter and compare it with the limit given.

Acceptable limit - 687 to 713 deg C

If either this reading or the reading obtained in paragraph (a) fail to meet the acceptable limit, adjust potentiometer No.28 until the readings are within both the respective acceptable limits. Make the appropriate T_1 potentiometer and ENG FLIGHT RATING selections while making each adjustment.

After adjustment of potentiometer No.28, carry out the procedures detailed in paragraphs (5) and (7).

NOTE: Adjustment of No.28 potentiometer affects the datums governed by potentiometers No.27 and No.29.

(7) Carry out the procedure detailed in paragraph (a) on all standards of amplifier and the additional check procedure, given in paragraph (b), on type /24DC amplifiers with the EGT switch retained in position 2.

(a) Ensure that the switches are in the following settings.

ENG RATING MODE	-	FLIGHT
ENG FLIGHT RATING	-	CRUISE
T_1 potentiometer	-	555 divisions

Press and hold the test set T alpha button, note the stabilized EGT reading shown on the test set frequency meter, release button and compare the reading with the limit given.

Acceptable limit - 650 to 676 deg C

On amplifiers type /24CA, /24CC and /24DC with EGT switch in position 1, adjust potentiometer No.27 until reading is within acceptable limit. On an amplifier type /24DC with EGT switch in position 2, record the reading and use in conjunction with the reading obtained in paragraph (b).

(b) On an amplifier type /24DC with EGT switch retained in position 2, set the T_1 potentiometer to 945 divisions and press and hold the test set T alpha button. Note the stabilized EGT reading shown on the test set frequency meter, release the button and compare the reading with the limit given.

Acceptable limit - 657 to 673 deg C

If either this reading or the reading obtained in paragraph (a) fail to meet the acceptable limit, adjust potentiometer No.27 until the readings are both within their respective limits. Make the appropriate T_1 potentiometer and ENG FLIGHT RATING selections while making each adjustment.

(8) On satisfactory completion of checks, return flight compartment and test set switches to their original settings (Ref.para.B.).

(9) If no further checks are required, complete the test procedure detailed in paragraph J.

F. N_1 Root Theta Limiter and N_1 Governor Datum Checks.

(1) Carry out basic procedure detailed in paragraph B.

(2) Make the following flight compartment and test set switch selections specific to this check.

Flight compartment selections:

Pilots throttle lever	-	MAX
THROTTLE MASTER	-	to amplifier connected for check (MAIN OR ALTERN)
ENG 4 T/O N_1 LIMITER	-	NORM

Test set selection:

T_1 pot - 378 divisions

(3) Note stablished N_1 frequency reading as shown on the test set frequency meter and compare it with the limit given.

Acceptable Limit - 4109 to 4133 Hz

If necessary, adjust potentiometer No.19 (Ref.para. C.(4)) until the reading is within the stated limit.

(4) Make the following flight compartment switch selections:

ENG RATING MODE	-	FLIGHT
ENG FLIGHT RATING	-	CLIMB

Increase the test set T_1 pot setting to 945 divisions and set RT switch on test set to the down position. Note the stabilized N_1 frequency meter. Compare the reading with the limit given.

Acceptable Limit - 4327 to 4369 Hz

If necessary, adjust potentiometer No.30 (Ref.para. C.(4)) until the reading is within the stated limits.

(5) On satisfactory completion of checks, return flight compartment and test set switches to their original settings (Ref.para.B).

(6) If no further checks are required, complete the test procedure detailed in paragraph J.

R G. Flame-out Circuit Clamp Datum Check and Operational Check
R of the Auto-relight Circuit.

(1) Carry out basic procedure detailed in paragraph B.

R (2) Ensure circuit breakers indicated in Table 507 are set.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
<u>Engine No.1</u>			
RH IGNITION CONT	1-213	1J2	N6
LH IGNITION CONT	3-213	1J1	E1
<u>Engine No.2</u>			
RH IGNITION CONT	1-213	2J2	P6
LH IGNITION CONT	3-213	2J1	E2
<u>Engine No.3</u>			
RH IGNITION CONT	1-213	3J2	Q6
LH IGNITION CONT	3-213	3J1	E3
<u>Engine No.4</u>			
RH IGNITION CONT	1-213	4J2	R6
LH IGNITION CONT	3-213	4J2	E4

Circuit Breakers
Table 507

(3) Make the following flight compartment and test set switch selections specific to this check.

Flight compartment selections:

AUTO IGNITION - ON
Pilots throttle lever - MAX
THROTTLE MASTER - to amplifier connected for check (MAIN OR ALTERN)

R
R
R <u>CAUTION:</u> ENSURE THAT START PUMP SUPPLY AND RH AND LH IGNITION SUPPLY CB'S ARE PULLED (REF. TABLE 507A).

R HP fuel valve switch to open.
Test set selections:

SW 2 - position 5
T_1 pot - 378 divisions

R	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
R	<u>Engine No.1</u>			
R	RH IGNITION SUPPLY	1-213	1J4	N5
R	LH IGNITION SUPPLY	2-213	1J3	E12
R	START PUMP SUPPLY	1-213	1Q812	J6
R	<u>Engine No.2</u>			
R	RH IGNITION SUPPLY	1-213	2J4	P5
R	LH IGNITION SUPPLY	2-213	2J3	B10
R	START PUMP SUPPLY	1-213	2Q812	K6
R	<u>Engine No.3</u>			
R	RH IGNITION SUPPLY	1-213	3J4	Q5
R	LH IGNITION SUPPLY	2-213	3J3	B11
R	START PUMP SUPPLY	1-213	3Q812	L6
R	<u>Engine No.4</u>			
R	RH IGNITION SUPPLY	1-213	4J4	R5
R	LH IGNITION SUPPLY	2-213	4J3	E13
R	START PUMP SUPPLY	1-213	4Q812	M6

R Circuit Breakers
R Table 507A

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(4) Depress and hold the test set F/O button, note the percentage reading shown on the test set meter and release button. Compare the reading with the limit given.

Acceptable limit - minus 10% to plus 50%

If necessary, adjust potentiometer No.8 (Ref.para.C.(4)) until the reading is within the stated limit.

R (5) Observe that flight compartment N_2 indication increase slowly to 67% and then at faster rate to maximum power with ingnition caption lights out.

(6) On satisfactory completion of check, return flight compartment and test set switches to their original settings (Ref.para.B.).

(7) If no further checks are required, trip circuit breakers (Ref.Table 507) and complete the test procedure detailed in paragraph J.

H. Maximum Reverse Thrust Datum Check.

(1) Carry out basic procedure detailed in paragraph B.

(2) Make the following flight compartment and test set switch selections specific to this check.

Flight compartment selections:

Pilots throttle lever - MAX
THROTTLE MASTER - to amplifier connected for check (MAIN OR ALTERN)

Test set selections:

RT - down
RBD - down
T_1 pot - 378 divisions

(3) Note stabilized N_2 frequency reading shown on the test set meter and compare it with the limit given.

Acceptable limit - 3788 to 3808 Hz

If necessary, adjust potentiometer No.10 (Ref.para.C.(4)) until the reading is within the stated limit.

(4) On satisfactory completion of check, return flight compartment and test set switches to their original settings (Ref.para.B.).

(5) If no further checks are required, complete the test procedure detailed in paragraph J.

J. Complete the Test Procedure.

(1) Disconnect the test set.

(a) Trip the engine control system circuit breakers (Ref.Table 504) and attach safety clips.

(b) Disconnect and remove test set cable 2 and replace plug and socket covers.

(c) Disconnect and remove test set cable 3 and replace the plug cover and the flight plug in amplifier socket SK 1.

(d) Set the engine control system circuit breakers, select the THROTTLE MASTER switch to the affected amplifier (MAIN or ALTERN) and check that the throttle failure warning is not activated. Set switch to OFF.

(2) Verify work is completed, remove safety clips and reset the circuit breakers (Ref.Table 503).

13. <u>Fault Identification Module Procedure</u>

A. General (Ref. Fig.523).

The type A6A16/24CC and A6A16/24DC engine control amplifiers (Ref. S.B.OL.593-76-8720-44 and 76-8745-47) incorporate a fault identification module (FIM) that has four light emitting diode indicators and a reset push-button. The FIM facility is made effective on the type A6A16/24CC amplifier by the incorporation of S.B.OL.593-76-8726-45 and will then enable some defects to be directly identified. A predetermined combination of indicators illuminate in response to each specific fault.

If a control system fault occurs, the control amplifier will initiate a warning and an automatic lane change in the normal way and also illuminate the indicators in the code combination appropriate to the defect as given in Table 1. The four indicators are numbered 1, 2, 4 and 8 and the code for a fault is the summation of the values of the illuminated indicators.

In addition to the indication, the module will store the fault code in a memory circuit and retain it even if the amplifier is switched off.

B. Fault Identification Code and Check Procedures.

(1) Switch on the suspect engine control amplifier and check the response.

(a) With an intermittent fault, the amplifier may switch on normally but the FIM indication will be activated by the memory and display the code for the initial fault.

(b) With a continuing fault, the throttle failure warning will be activated, a lane change occur and the FIM indication will display the code for the initial fault.

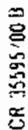
(c) Record the FIM code displayed as the total value of the indicators illuminated and switch off the amplifier.

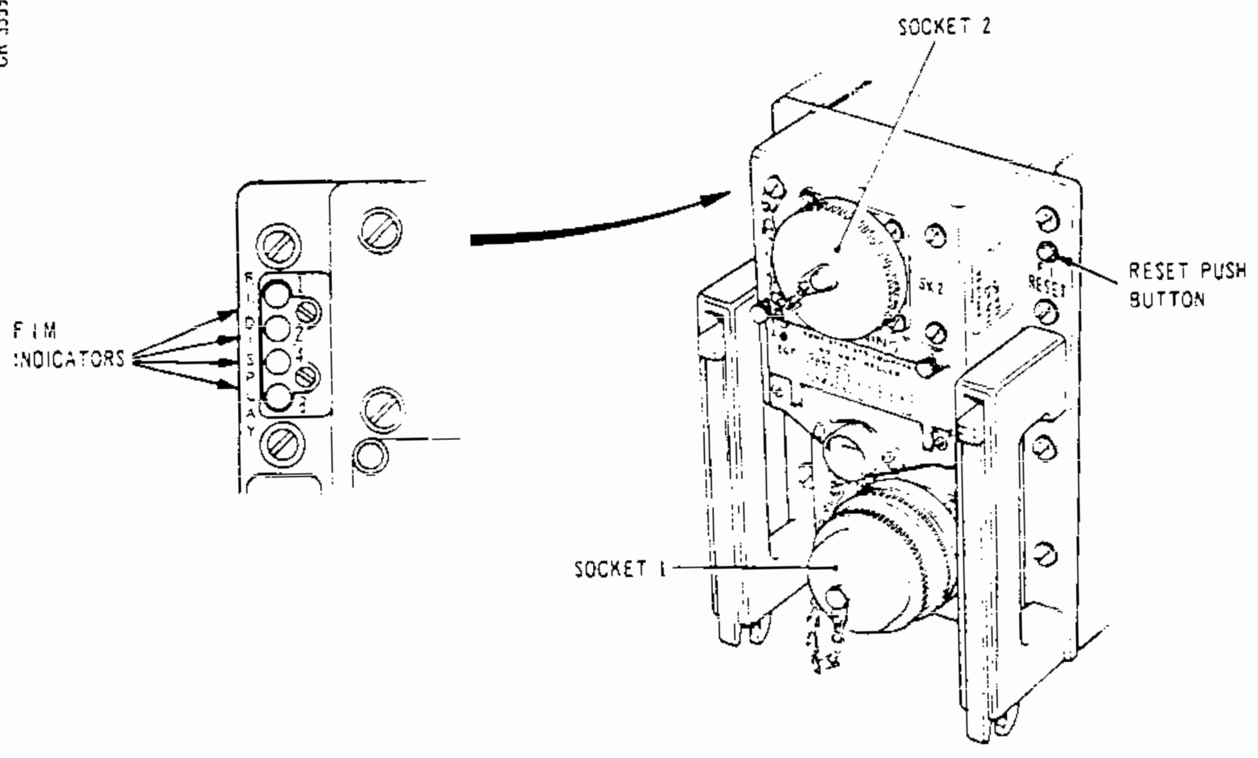
(d) Ascertain the fault from the code list of Table 517.

(e) If the FIM indication is code 1 or 3, ascertain which of the two faults indicated is the cause by use of the fault location test set PE.35480 as detailed in Fault Locating Tests, paragraph 8.

(2) Rectify the defect of the component or circuit wiring indicated.

(3) Switch on the engine control amplifier and check the response to ascertain if the fault has been rectified.





1
2
4
8

2 AND 4 ILLUMINATED
∴ 2+4 = CODE 6

1
2
4
8

1,4 AND 8 ILLUMINATED
∴ 1+4+8 = CODE 13

EXAMPLES OF FAULT IDENTIFICATION CODE

FIM Indicators and Coding Detail
Figure 523

CODE	DEFECTIVE CIRCUIT
0	No fault
1	Throttle actuator brake or PNC trim brake
2	115 Volts 400 Hz - low
3	Throttle actuator motor ref. or PNC trim motor ref.
4	LP compressor rpm probe
5	HP compressor rpm probe
6	Intake T_1 temperature probe
7	Spare
8	Pilot's lever transmitter
9	PNC trim tacho ref./signal
10	Throttle actuator tacho signal
11	PNC trim position ref./signal
12	Throttle actuator motor control
13	PNC trim motor control
14	Throttle actuator position ref./ signal
15	Amplifier internal fault

Table 517
Identification Code and Related Defect

(a) If there are no effective faults, the amplifier will switch on normally but the FIM indicators will be illuminated in the initial fault code. Reset the FIM as detailed in paragraph (5) for a check of the control system.

(b) If a fault remains, the failure warning and lane change will function and the FIM indicators will illuminate in the initial fault code. Switch off the amplifier and continue with the procedure in paragraph (4) and identify the fault.

NOTE: The FIM indicates and stores only the code of the first fault to occur. While any fault exists, the indication and memory store cannot be cleared by use of the reset button.

(4) Use the fault location test set PE.35480 or, if the test set is not available, carry out the following procedure to ascertain whether the initial fault persists or a second fault has developed.

NOTE: Should a second fault have occurred, it will not activate the FIM display or memory until after the initial fault has been cleared.

(a) Transfer the amplifier from the position giving a fault indication to a known serviceable position, switch on and check the response.

(b) If the failure warning and lane change facilities function, the fault is in the amplifier. Carry out the relevant amplifier adjustment/test and rectification procedure.

(c) If the amplifier switches on normally it is satisfactory. Reset the FIM as detailed in paragraph (5), switch off the amplifier and transfer it to its original position. Again switch on and check the response.

(d) The fault will cause a failure warning and lane change and activate the FIM indication. Evaluate the code displayed.

(i) If the same code is displayed, then the current fault is in the same circuit as the initial fault. Locate and rectify the defect and repeat the recheck procedure detailed in paragraph (3).

(ii) If a second fault has occurred, a new code will be displayed. Locate and rectify the defect and repeat the recheck procedure detailed in paragraph (3).

(5) With the amplifier switched on, reset the FIM facility.

(a) Press the reset button and check that all the FIM indicators illuminate as a self-test facility.

(b) Release the reset button to clear the memory shown by the extinguishing of all four indicators This is the code for no fault.

(c) Switch off the amplifier.

(6) Before an engine start, ensure that the FIM is effective and the memory is clear by use of the reset button as detailed in paragraph (5).

14. Engine Rating Selection Circuits - Operational Test (Ref.Fig.524)

A. Preparation

(1) Connect and switch on electrical ground power (Ref.24-41-00).

(2) Ensure that the landing gear weight switches are in the 'aircraft-on-ground' position.

(3) On the ENGINE STARTING panel at the third crew member's station, place each ignition control switch to "OFF".

(4) On the pilots' roof panel, set each of the following switches as indicated:

(a) Auto ignition switches to "OFF".

(b) HP valve switches to "OFF".

(c) ENG RATING MODE switches to "TAKE OFF".

(d) ENG FLIGHT RATING switches to "CLIMB".

(5) Move each throttle lever fully rearward and ensure that each thrust reverse lever is fully 'down'.

(6) Position the reheat (RHT) switches on the pilots' centre console to "OFF".

(7) Check that the T/O caption on the pilots' centre dash panel illuminates.

B. Test - Manual

(1) Hold the ENG RATING MODE switches to "FLIGHT".

(2) Check that the T/O caption is extinguished and that the CLB caption immediately beneath it is illuminated.

(3) Set each ENG RATING MODE switch in turn to "TAKE OFF" and back to "FLIGHT". Check that the T/O caption illuminates each time and that the CLB caption remains illuminated throughout.

(4) Return the ENG RATING MODE switches to "TAKE OFF" and check that the T/O caption only is illuminated.

(5) Hold each ENG RATING MODE switch in turn to "FLIGHT" and operate the corresponding ENG FLIGHT RATING switch from CLIMB to "CRUISE" and back to "CLIMB". Check that the CLB and CRS captions illuminate in agreement with the switch positions and that the T/O caption remains illuminated throughout the operation.

(6) Return the ENG RATING MODE switches to "TAKE OFF".

(7) Select each RHT switch in turn to CTY and back to OFF. Check that the CTY caption on the centre dash panel illuminates at each operation. Check that the T/O caption remains illuminated throughout this operation.

C. Test - Auto

(1) Press the T/O arming button on the centre dash panel.

(2) Select the RHT switches to "RHT" in turn and check that the reheat select light on the AJ indicators illuminates. Check that the CTY caption is flashing.

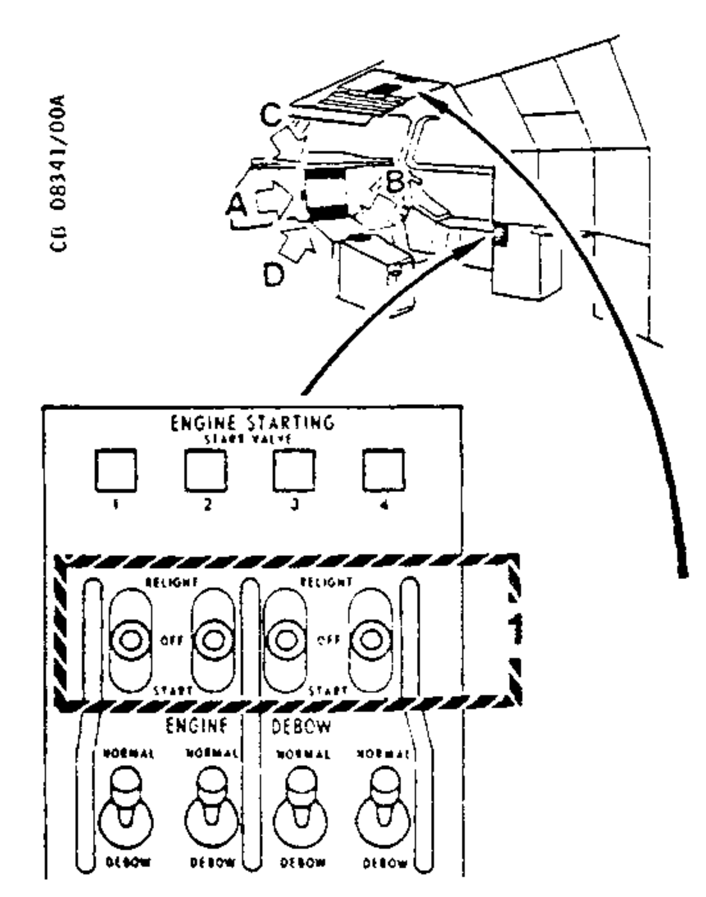
(3) Select the RHT switches "OFF" and check that the CTY caption goes out.

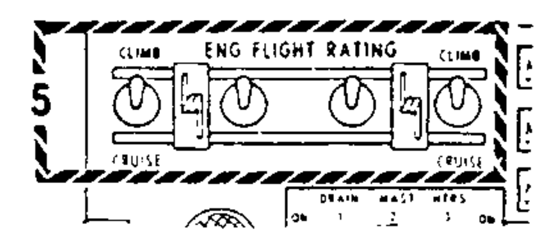
(4) Pull out the T/O button to inhibit.

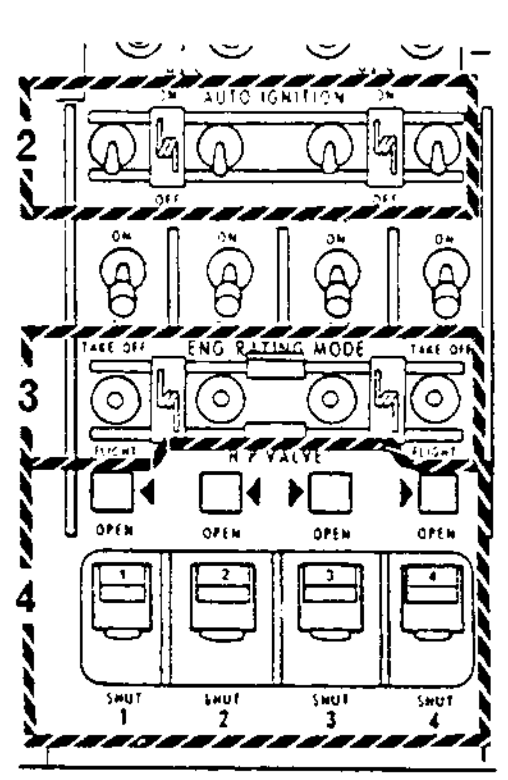
D. Conclusion

(1) Switch off and disconnect electrical ground power (Ref. 24-41-00).

CB 08341/00A





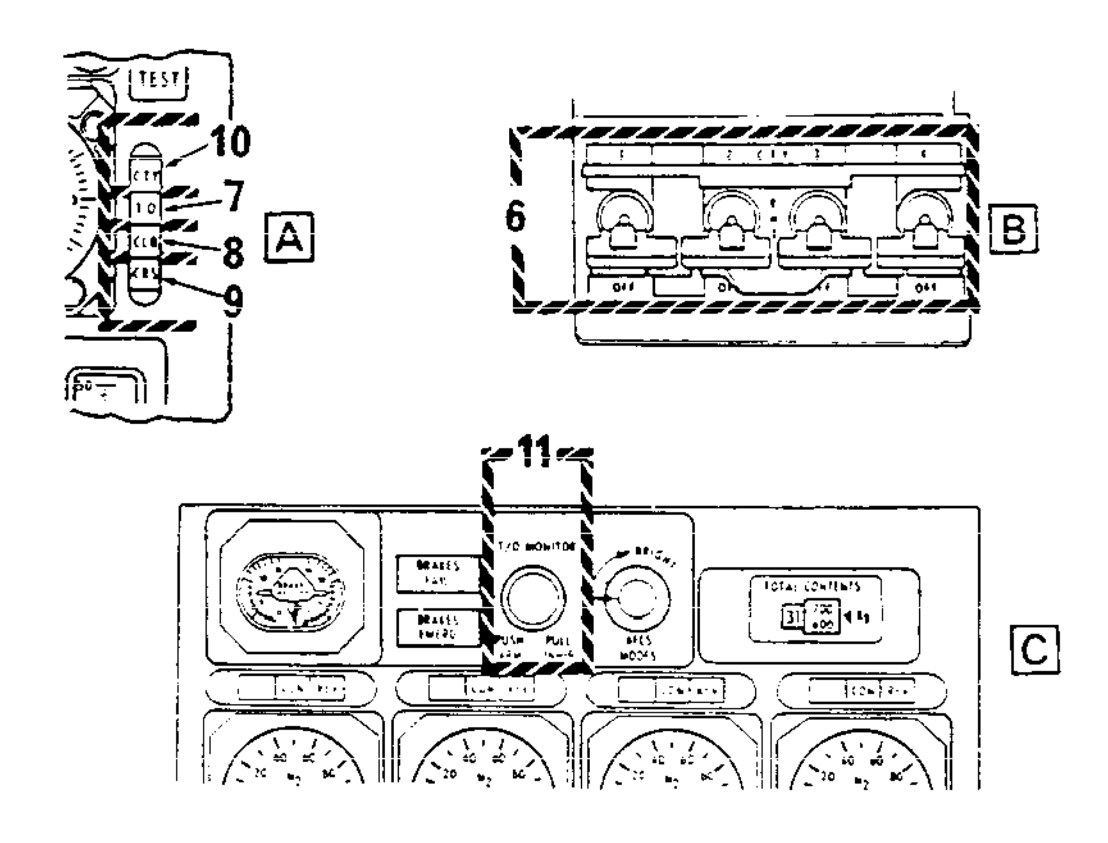


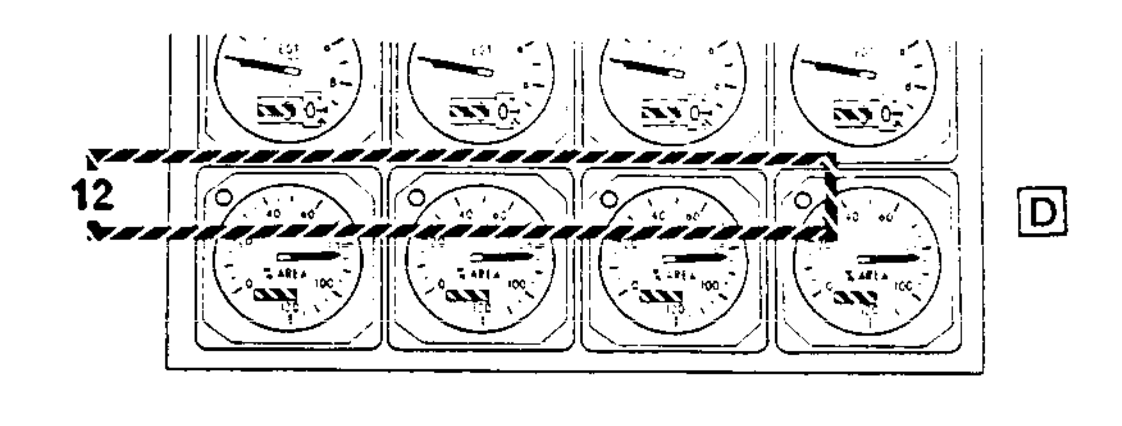
1. IGNITION CONTROL SWITCHES
2. AUTO-IGNITION CONTROL SWITCHES
3. ENG. RATING MODE CONTROL SWITCHES
4. HP VALVE CONTROL SWITCHES
5. ENG. FLIGHT RATING CONTROL SWITCHES
6. REHEAT CONTROL SWITCHES
7. T/O CAPTION
8. CLB CAPTION
9. CRS CAPTION
10. CTY CAPTION
11. T/O MONITOR BUTTON
12. REHEAT SELECTED LIGHTS

CMB 76 11 00 5 NAMA

Controls and Indicators (Sheet 1 of 2)
Figure 524)

CB 08385/00A





CMB 76 11 00 5 NAMB

Controls and Indicators (Sheet 2 of 2)
Figure 524)

R 15. <u>T1 Probe Signal Check</u>

R A. Equipment and Materials.

R	DESCRIPTION	PART NO.
R	Reheat Test Set	997-531-034
R	Digital Multimeter	FLUKE 75 (or equivalent)
R	Temperature Probe Attachment	80T150U
R	Calculator	As available

R B. Prepare for T1 Probe Signal Test using the Reheat Test Set.

R (1) Remove the rear equipment racking panels, No.1 and 2
R engines Zone 243, No.3 and 4 Zone 244.

R (2) Make available ground power (Ref.24-41-00,
R Servicing).

R (3) Check that the relevant circuit breakers are set:

R	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
R	<u>Engine No.1</u>			
R	REHEAT CONTROL	15-216	1K1542	E9
R	REHEAT AMP SUPPLY	14-215	1K1541	C12
R	MAIN THROT SUPPLY	2-213	1K1	F12
R	MAIN THROT CONT	1-213	1K3	A1
R	ALTN THROT SUP	14-215	1K2	G12
R	ALTN THROT CONT	15-216	1K4	E8
R	<u>Engine No.2</u>			
R	REHEAT CONTROL	15-215	2K1542	D15
R	REHEAT AMP SUPPLY	13-215	2K1541	B14
R	MAIN THROT SUPPLY	2-213	2K1	C12
R	MAIN THROT CONT	1-213	2K3	A3
R	ALTN THROT SUP	13-215	2K2	F14
R	ALTN THROT CONT	15-215	2K4	F15

R Table 518 (Continued)

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
<u>Engine No.3</u>			
REHEAT CONTROL	15-215	3K1542	D16
REHEAT AMP SUPPLY	13-216	3K1541	B7
MAIN THROT SUPPLY	2-213	3K1	C13
MAIN THROT CONT	1-213	3K3	A4
ALTN THROT SUP	13-216	3K2	A7
ALTN THROT CONT	15-215	3K4	F16
<u>Engine No.4</u>			
REHEAT CONTROL	15-216	4K1542	E10
REHEAT AMP SUPPLY	14-216	4K1541	D7
MAIN THROT SUPPLY	2-213	4K1	F13
MAIN THROT CONT	3-213	4K3	A2
ALTN THROT SUP	14-216	4K2	C7
ALTN THROT CONT	15-216	4K4	F11

Table 518 (Concluded)

(4) Prepare the test set:

(a) Place the mode selector to DYN.

(b) Select test set switch OFF.

(c) Select Tt1, Fe, Fr, NL switches OFF.

(5) Connect the Reheat Test Set to the Reheat Amp for the T1 system to be tested.

CR 36637/00A

REHEAT CONTROL AMPLIFIER

REHEAT TEST SET

R Reheat Test Set Connected to Reheat Control
R Figure 525

ENGINE NO.	RACK	AMPLIFIER
No.1	3-243	1K1553 Reheat No.1
No.2	4-243	2K1553 Reheat No.2
No.3	4-244	3K1553 Reheat No.3
No.4	6-244	4K1553 Reheat No.4

Table 519

(6) Measure the local temperature in the immediate vicinity of the T1 probe, both in the intake to be tested and the adjacent. When using the digital Multimeter allow at least 6 seconds for the reading to stabilise.

<u>WARNING:</u> TEMPERATURE MEASUREMENTS ARE TO BE TAKEN FROM THE INTAKE LIP. TO ENTER THE INTAKE MAY RESULT IN PERSONAL INJURY.

NOTE: IF THE ENGINE HAS BEEN RUNNING OR THE T1 HEATER HAS BEEN 'ON', A DIRECT READING OF TEMPERATURE FROM THE PROBE WILL BE REQUIRED. SAFETY PRECAUTIONS MUST BE TAKEN BEFORE ENTERING THE INTAKE REF. MM.71-00-00, PAGE 303.

C. Test the T1 Probe Signal using Reheat Test Set.

(1) Select the TEST SET switch ON and check that the 28V and 115V indicators illuminate.

(2) Press the TEST IND LIGHTS push button and check that all the indicating lights illuminate.

(3) Select the test set Tt1 switch to 'ON'.

(4) Check that the 'Tt1 U' voltmeter reads ZERO.

(5) At the roof panel 4-211, select the THROTTLE MASTER switch to MAIN.

(6) On the test set note the 'Tt1 U' voltmeter reading, refer to fig.526 convert to temperature. Compare with the recorded localised temperature of the intake, investigate any readings differing by more than 5 degrees. Refer to troubleshooting chart 71-00-57, chart 105A.

NOTE: As an alternative to fig.526 the indicated temperature can be calculated from the 'Tt1 U' voltmeter reading using the formulae:

$$T1 \text{ (degree's C)} = (7200/V^2) - 273$$

Example: If 'Tt1 U' voltmeter reads '4.95 volts'. T1 in degree's C is:

$$T1 = \left(\frac{7200}{4.95^2}\right) - 273$$

$$= \left(\frac{7200}{24.50}\right) - 273$$

$$= 293.87 - 273$$

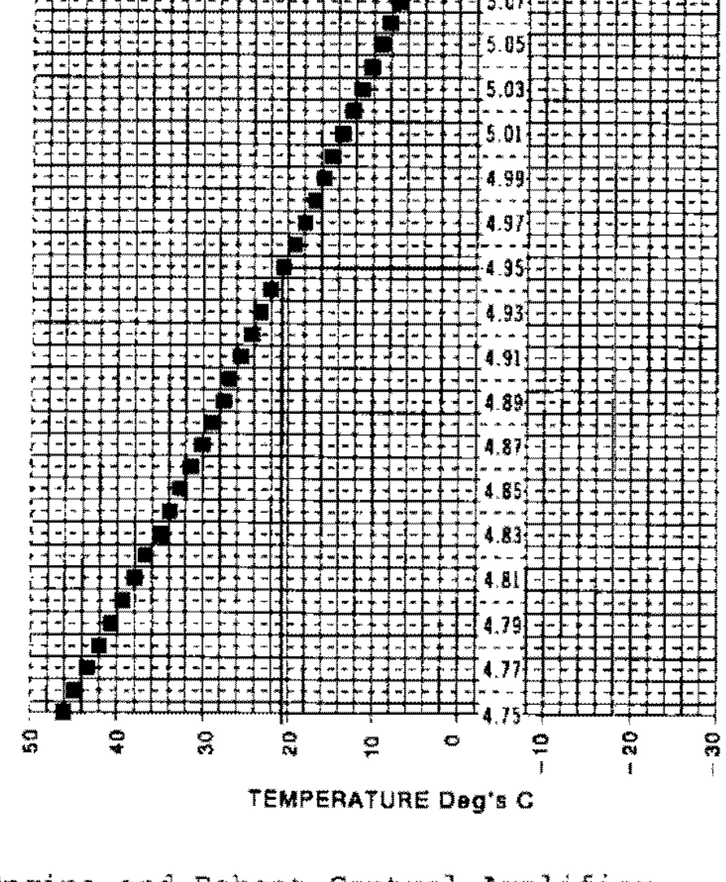
$$T1 = 20.87 \text{ degree's C.}$$

(7) At the roof panel 4.211 select the THROTTLE MASTER switch to ALTERNATE.

(8) Repeat step (6) comparing the temperature of the ALTERNATE lane in the adjacent intake, investigate any readings differing by more than 5 degrees. Refer to troubleshooting chart 105A.

(9) Select the TEST SET to OFF and disconnect the test set.





R Engine and Reheat Control Amplifier
R T1 Signal Check
R Figure 526

(10) Connect the test set to the adjacent engine Reheat Amplifier, follow operations (1) to (9) to determine the temperature indicated by the T1 system through the remaining coils, note table 520.

T1 PROBE	MAIN COIL	ALT COIL
NO.1 INTAKE	NO.1 MAIN ECA	NO.2 ALT ECA
NO.2 INTAKE	NO.2 MAIN ECA	NO.1 ALT ECA
NO.3 INTAKE	NO.3 MAIN ECA	NO.4 ALT ECA
NO.4 INTAKE	NO.4 MAIN ECA	NO.3 ALT ECA

Table 520

(11) Select the TEST SET to OFF and disconnect the test set.

(12) Repeat operations (1) to (11) on the remaining engines as required.

D. Conclusion.

(1) At the roof panel 4-211, select all the THROTTLE MASTER switches to OFF.

(2) Refit the rear equipment panels removed in Zone 243/4.

(3) Remove electrical ground power (Ref.24-41-00, Servicing).

(4) Return circuit breakers to the normal settings.

ACTUATOR GEARBOX (TV) - DESCRIPTION AND OPERATION

1. General

The throttle valve actuator gearbox, shown in Figure 1, is bolted to the bottom face of the FCU. The actuator gearbox has a drive quillshaft in splined engagement with the throttle valve drive of the FCU as determined by a master spline. Assembly pins locate the mating faces of the two units between which a seal plate is located. The actuator gearbox positions the throttle valve in response to signals received from the engine control amplifier.

2. Description

The actuator gearbox has an outer casing enclosing two chambers. A train of gears is contained in the chamber open to the throttle valve and is immersed in the fuel entering from the FCU. An outlet port in the joint face provides for the spill return fuel flow. Two a.c. motors and two synchro transmitters are mounted in the other chamber so that their drives project into the gear chamber and are in engagement with the gear train. Both motors are in engagement with a differential gear that transmits the drive of either motor to the gear train.

Each motor is paired with a synchro transmitter to serve one lane of control and incorporates an electro-magnetic brake. The duplication of the motors and synchro transmitters is the actuator safety factor in the two lane control system.

There are two electrical receptacles for the harness lead connections, one for each of the two driving motors. A drains outlet is provided to which the engine seal failure drains system is connected. A graduated throttle valve angle scale is located internally to indicate the throttle valve position. The scale can only be seen when the seal drains connection union is removed.

(Ref. Fig. 001)

3. Operation

The actuator gearbox acts in response to signals from the effective engine control amplifier. The control signal will be in a sense to turn the motor in the direction necessary to reset the throttle valve to meet the power demand. The effective motor will respond to the control signal and drive the throttle valve through the gear train. The brake locks the dormant motor and the effective motor drive is applied by the action of the differential gearing. Position and velocity feedback signals will be transmitted by the

CR 31992/110B

RECEPTACLES
ACTUATOR MOTORS
OUTER CASING
SEAL PLATE ASSEMBLY
FUEL SPILL OUTLET
CONNECTION BLOCK
GEAR TRAIN
COVER PLATE
SPIDER
SYNCHRO TRANSMITTERS
QUILL SHAFT

CMR 76 11 01 0 AAMO

MAIN MOTOR DRIVE
GEAR HOUSING INCORPORATES GEARS 5 AND 8
DIFFERENTIAL ACTION DRIVES GEAR HOUSING 8 THROUGH GEARS 6 AND 7
SHAFT DRIVEN BY DIFFERENTIAL MAINSHAFT
DIFFERENTIAL MAINSHAFT
THROTTLE VALVE ANGULAR SCALE
MAIN SYNCHRO TRANSMITTER
DIFFERENTIAL GEARED HOUSING
SPLIT GEARSHAFT
QUILL SHAFT ENGAGES FCU THROTTLE VALVE STOP PLATE ON VALVE DRIVESHAFT
ALTERNATIVE MOTOR DRIVE
GEAR HOUSING ROTATES THROUGH DIFFERENTIAL ACTION OF PLANET GEARS. PLANET GEAR 7 ACTS AS IDLING GEAR
ALTERNATIVE SYNCHRO TRANSMITTER

MAIN DRIVE TO FCU THROTTLE VALVE

ALTERNATIVE DRIVE TO FCU THROTTLE VALVE

Actuator Gearbox (TV) and Drives
Figure 001

R

associated synchro transmitter and motor to the engine control amplifier in command. These signals are used by the amplifier to modify the control signal so that the rate of movement is controlled and the throttle valve movement is arrested immediately it reaches the position demanded.

ACTUATOR GEARBOX (TV) - REMOVAL/INSTALLATION

1. General

The throttle valve actuator gearbox is bolted to the bottom face of the FCU.

The following procedures apply to both pre and S.B.OL.593-76-22 and 76-8534-32 standard engines.

Details of approved servicing and storage materials quoted in this chapter are given 70-00-01.

2. Tools and Equipment

Electrical Systems test set (ESTS) ... PE.21500

Adapter spanner PE.24297

Gauge PE.24296

Circuit breaker safety clip ... ... -

3. Actuator - Removal/Installation (Ref. Fig. 401)

A. Prepare for Removal.

(1) Close LP fuel isolation valve and ensure that the valve indicator shows shut.

(2) Open engine bay front lower doors (Ref.71-00-00, Servicing).

(3) Electrically isolate the engine additional services indicated in Table 401 by tripping the circuit breakers affecting the engine upon which work is to be carried out. Attach safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
Engine No.1			
LP VALVE SUP 1	15-216	1Q1	C1
LP VALVE SUP 2	16-215	1Q2	-
MAIN THROT SUP	2-213	1K1	F12
MAIN THROT CONT	3-213	1K3	A1
ALTN THROT SUP	14-215	1K2	G12
ALTN THROT CONT	15-216	1K4	E8

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
Engine No.2			
LP VALVE SUP 1	15-216	2Q1	F2
LP VALVE SUP 2	15-215	2Q2	C19
MAIN THROT SUP	2-213	2K1	C12
MAIN THROT CONT	1-213	2K3	A3
ALTN THROT SUP	13-215	2K2	F14
ALTN THROT CONT	15-215	2K4	F15
Engine No.3			
LP VALVE SUP 1	15-216	3Q1	F1
LP VALVE SUP 2	15-215	3Q2	C20
MAIN THROT SUP	2-213	3K1	C13
MAIN THROT CONT	1-213	3K3	A4
ALTN THROT SUP	13-216	3K2	A7
ALTN THROT CONT	15-215	3K4	F16
Engine No.4			
LP VALVE SUP 1	15-216	4Q1	C2
LP VALVE SUP 2	16-215	4Q2	-
MAIN THROT SUP	2-213	4K1	F13
MAIN THROT CONT	3-213	4K3	A2
ALTN THROT SUP	14-216	4K2	C7
ALTN THROT CONT.	15-216	4K4	F11

Circuit Breakers
Table 401

B. Remove Actuator.

(1) Disconnect electrical lead end plugs from the two connections on the actuator gearbox.

(2) Remove plug from actuator gearbox rear face and drain fuel into container. Re-install plug temporarily.

NOTE: Discard drained fuel or inhibiting fluid.

(3) Remove fluid passage bolt and two sealing washers then detach the seal failure drains system from actuator gearbox drains outlet connection.

R (4) Support actuator gearbox, remove attachment bolts,
R washers and lower actuator gearbox squarely until

drive and dowels disengage and remove actuator gearbox.

(5) Remove two retaining screws and seal plate.

R (6) If the actuator gearbox is not to be re-installed
R within 48 hours, it must be inhibited in accordance
R with the instructions detailed in the manufacturers
R Component Overhaul Manual (76-11-01).

C. Prepare to Install Actuator Gearbox.

(1) If a new actuator gearbox is to be installed ensure that inhibiting fluid has been drained from the gearbox.

(2) Carry out a torque check on the actuator gearbox drive (Ref.Fig.402).

(a) Remove seal drains connection union and strainer assembly and sealing washer and expose indicator scale.

(b) Assemble adapter (PE.24297) and torque-wrench to gearbox quillshaft.

(c) Note the drive setting as indicated by the scale. The quillshaft is turned clockwise (looking on drive) to move indicator scale from zero to open.

(d) Within a limit of 4 lbf in, progressively apply a torque load to the drive shaft and turn the gearbox through its full range as indicated on the scale, 0 to 130 deg. Full movement must be obtained within the limit for the unit to be acceptable.

(e) Install the union and strainer assembly temporarily to the actuator gearbox.

(3) Assemble serviceable seal plate (Ref.70-00-03, Sealing Devices) to actuator gearbox mounting face and secure it with two screws. Ensure that screws do not project above seal plate face.

CR 31055/00B

A

FCU

RETAINING SCREWS

SEAL PLATE

THROTTLE VALVE CONTROL ACTUATOR

INDICATOR SCALE

A

SEALING WASHER

PLUG

UNION AND
STRAINER ASSEMBLY

CMR 76 11 01 4 AAM0

ELECTRICAL
CONNECTIONS

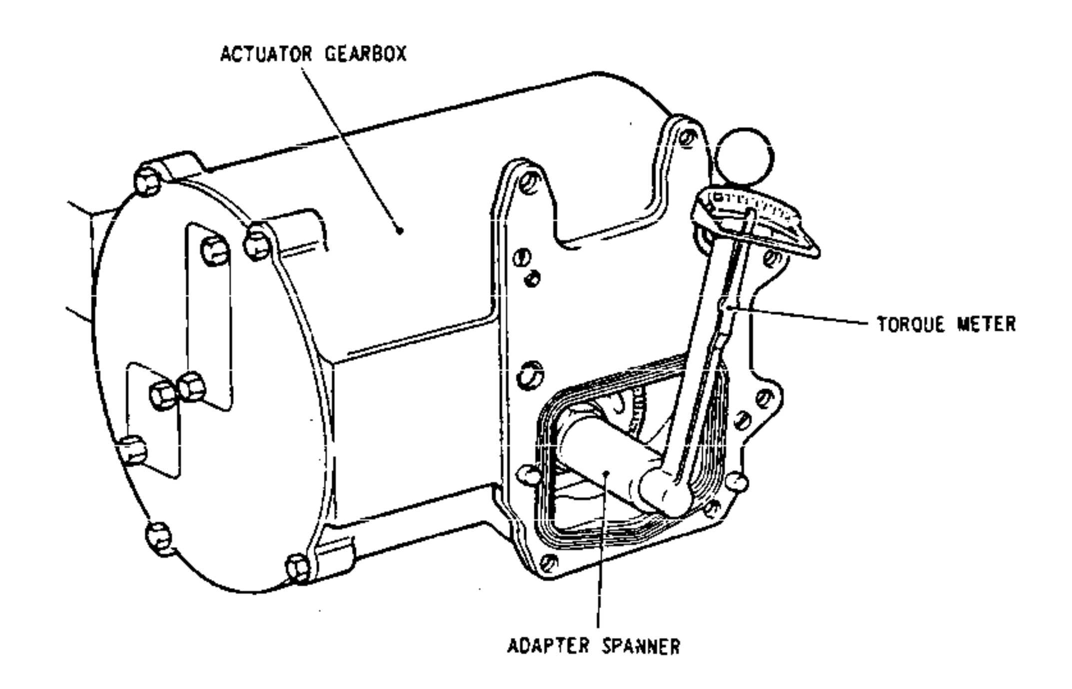
SEALING WASHER

FLUID PASSAGE BOLT

SEAL FAILURE DRAINS SYSTEM TUBE

Throttle Valve Actuator Gearbox Removal/Installation
Figure 401

CR 31785/00A



CMR 76 11 01 4 BAM0

Actuator Gearbox Torque Check
Figure 402

R CAUTION: IT IS OF THE UTMOST IMPORTANCE THAT THE
R STRAIGHTNESS CHECK ON THE FCU THROTTLE
R VALVE DRIVE SHAFT AND THE SPLINE
R ALIGNMENT CHECKS OF THE ACTUATOR GEARBOX
R AND FCU DRIVE SHAFTS (REF.73-21-01, PAGE
R BLOCK 600 AND 76-11-01 PAGE BLOCK 400)
R ARE CARRIED OUT BEFORE INSTALLATION.
R SERIOUS OPERATIONAL PROBLEMS MAY OCCUR IF
R THESE CHECKS ARE NOT CARRIED OUT.

R (4) Carry out straightness check on the flow control unit
R throttle valve drive shaft (Ref.73-21-01, Inspection/
R Check).

D. Install Actuator Gearbox.

NOTE: If the actuator gearbox is to be installed to a newly installed FCU/SSP, ensure that the transportation gasket 77246474 has been removed from the FCU mounting face.

R CAUTION: IT IS OF THE UTMOST IMPORTANCE THAT THE
R STRAIGHTNESS CHECK ON THE FCU THROTTLE VALVE
R DRIVE SHAFT AND THE SPLINE ALIGNMENT CHECKS OF
R THE ACTUATOR GEARBOX AND FCU DRIVE SHAFTS
R (REF.73-21-01, PAGE BLOCK 600 AND 76-11-01
R PAGE BLOCK 400) ARE CARRIED OUT BEFORE
R INSTALLATION. SERIOUS OPERATIONAL PROBLEMS
R MAY OCCUR IF THESE CHECKS ARE NOT CARRIED OUT.

(1) Align actuator gearbox and FCU drive shafts (Ref.Fig.403).

(a) Turn actuator gearbox quillshaft with adapter spanner (PE.24297) and align master spline with gauge (PE.24296) coupling master spline.

CAUTION: DO NOT FORCE GAUGE COUPLING INTO ENGAGEMENT WITH ACTUATOR GEARBOX QUILLSHAFT.

(b) Locate gauge dowel holes with actuator gearbox dowels and ensure that gauge coupling readily engages with actuator gearbox quillshaft. If difficulty is experienced, remove gauge, recheck alignment of master splines and re-attempt engagement. Repeat this operation as necessary.

(c) Remove gauge from actuator gearbox.

(d) Turn FCU stop plate coupling to align master spline with gauge shaft master spline.

<u>CAUTION:</u> DO NOT FORCE GAUGE SHAFT INTO ENGAGEMENT WITH THE FCU STOP PLATE COUPLING.

(e) Locate gauge dowels with FCU dowel holes and ensure that gauge shaft readily engages with FCU stop plate coupling. If difficulty is experienced, remove gauge, re-check alignment of master splines and re-attempt engagement. Repeat this operation as necessary.

(f) Remove gauge from FCU.

(2) Prime actuator gearbox with clean approved fuel, approximately 800 cc, by filling via the mounting face aperture.

R <u>CAUTION:</u> IT IS OF THE UTMOST IMPORTANCE THAT THE
R STRAIGHTNESS CHECK ON THE FCU THROTTLE
R VALVE DRIVE SHAFT AND THE SPLINE
R ALIGNMENT CHECKS OF THE ACTUATOR GEARBOX
R AND FCU DRIVE SHAFTS (REF.73-21-01, PAGE
R BLOCK 600 AND 76-11-01 PAGE BLOCK 400)
R ARE CARRIED OUT BEFORE INSTALLATION.
R SERIOUS OPERATIONAL PROBLEMS MAY OCCUR IF
R THESE CHECKS ARE NOT CARRIED OUT.

(3) Carefully engage splines and dowels and press actuator gearbox into position on FCU by hand pressure. If difficulty is experienced in engagement repeat the alignment procedure detailed in paragraph (1).

(4) Hold actuator gearbox in position with FCU mating face and seal plate in full contact and retain in position with six washers and bolts.

(5) Torque-tighten bolts, in increments to avoid seal distortion, to 86 lbf in. (9,7 N.m).

E. Carry Out Functional Check.

(1) Connect, tighten and wire-lock electrical lead end plugs to actuator gearbox.

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CR 31567/00A

ACTUATOR GEARBOX

GAUGE SHAFT MASTER SPLINE

A

QUILL SHAFT MASTER SPLINE

CMR 76 11 01 4 CAM0

STOP PLATE COUPLING MASTER SPLINE

FLOW CONTROL UNIT

GAUGE COUPLING MASTER SPLINE

GAUGE

MASTER SPLINE

A

- Aligning Actuator Gearbox and FCU Quillshaft
Figure 403

(2) Use the electrical systems test set ESTS and check actuator gearbox operation.

(a) Remove seal drains connection union and strainer assembly and expose indicator (Ref. Fig. 402).

(b) Connect ESTS to engine electrical harness at breakpoint and carry out actuator gearbox functional checks as detailed in 71-50-00, Adjustment/Test.

R B (c) Observe indicator readings through drains
R B connection aperture and ensure that a full range
R B of movement is obtained: Open 78-85 deg.,
R B closed 10-18 deg.

(3) On completion of functional check, remove ESTS and install union and strainer assembly.

(a) Remove ESTS and re-connect engine electrical harness plugs at breakpoint (Ref.71-00-12, Removal/Installation).

(b) Assemble new sealing washer to union and strainer assembly and screw assembly into its location. Torque-tighten to between 160 and 170 lbf in. (18,1 and 19,2 N.m) then wire-lock to secure.

F. Check for Leaks at Connections Disturbed During Procedure.

(1) If a static pressure test for fuel leaks is to be carried out, use either the aircraft fuel feed pumps or the pressure test and inhibiting rig (PTIR).

(a) Feed pump pressure - comply with the procedures given in 76-11-01, Adjustment/Test, paragraph 2.

(b) PTIR pressure - comply with the procedures given in 76-11-01, Adjustment/Test, paragraph 3.

(c) On completion of static pressure test and removal of any installed test equipment, continue with the installation procedure of paragraph G.

(2) If a leak check is to be carried out during an engine run, continue with the installation procedure of paragraph G.

G. Complete the Installation.

(1) Connect seal failure drains system to actuator gearbox seal drains outlet connection.

(a) Apply lubricant A to fluid passage bolt.

(b) Position a new sealing washer at each side of the multiple connector and secure to the actuator gearbox with a fluid passage bolt torque-tightened to between 150 and 170 lbf in (17 and 19,2 Nm).

(c) Wire-lock bolt and tube union nuts.

(2) Remove safety clips, reset circuit breakers (Ref.Table 401) and open LP fuel isolation valve.

(3) Carry out system check.

(a) With aircraft power supply available, select engine THROTTLE MASTER switch to MAIN and ALTERN amplifiers in turn.

(b) For a satisfactory check, no warning light must illuminate.

(4) If a leak check is to be made during an engine run.

(a) Start appropriate aircraft fuel feed pumps and carry out a preliminary leak check at connections and the seal drains outlet at drains tank overflow vent. No leaks are acceptable. On completion of check, switch off the aircraft fuel feed pumps.

(b) Reset the circuit breakers tripped for the opening of the engine bay doors (Ref.71-00-00, Servicing) that are required for the engine run checks, and comply with the procedures of 73-00-00 and 71-00-00, Adjustment/Test respectively. On completion of engine run, retrip circuit breakers and attach safety clips.

(5) Close engine bay doors (Ref.71-00-00, Servicing).

R

following unit removal.

B. Inhibit the Actuator Gearbox.

CAUTION: BEFORE ANY INHIBITING IS COMMENCED INSTALL DUST CAPS TO RECEPTACLES.

(1) Assemble the dust caps to the two electrical receptacles.

(2) Assemble the dust cap to the union and strainer assembly.

(3) Drain all fuel from the actuator gearbox.

(4) Thoroughly clean the actuator gearbox exterior with white spirit or Stoddard solvent, then dry the unit.

(5) Position the actuator gearbox with its mounting flange uppermost, pour inhibiting fluid A into the aperture until the gearbox is filled.

(6) Position the gasket and the transportation plate to the actuator gearbox mounting flange and secure in position with the four bolts, washers and nuts.

(7) Clean and dry the actuator gearbox exterior then examine the transportation plate for signs of leakage. Renew as required.

(8) Attach to the actuator gearbox a label recording date and details of inhibiting.

(9) Ensure that the bonded seal plate and the two countersunk screws are placed in a clean linen bag and accompany the actuator gearbox.

ACTUATOR GEARBOX (TV) - ADJUSTMENT TEST

1. General

This chapter is complementary to the Removal/Installation of the actuator gearbox and details the procedures for leak checks by application of a static pressure. Paragraph 2 details the leak checks using the aircraft fuel feed pumps and paragraph 3 details the leak checks using the pressure test and inhibiting rig (PTIR).

Details of approved servicing and storage materials quoted in this chapter are given in 70-00-01.

2. Leak Check with Aircraft Fuel Feed Pumps

A. General

The actuator gearbox and associated connections are leak checked using the appropriate aircraft fuel feed pumps.

B. Leak Check Actuator Gearbox and Associated Connections.

(1) Apply static pressure and check for leaks.

(a) Remove the safety clips and reset circuit breakers (76-11-01, Removal/Installation, (Table 401).

(b) Ensure that all fuel connections are secure, open LP fuel isolation valve and start the appropriate aircraft fuel feed pumps.

(c) With feed pump pressure applied check the drains outlets of the connections under test. No leaks are acceptable.

(d) On completion of check, switch off pumps.

(2) If a seal failure drains connection leakage should occur.

(a) Establish the location of the defective seal by reference to paragraph 3.G.

(b) Renew a defective seal or component and then repeat the leak check.

3. Leak Check Using PTIR

A. General

R This paragraph details the procedure for a pressure test
R and leak check using the PTIR and pressure test equipment.
R On completion of the PTIR checks a final leak check is
R required using the aircraft fuel feed pumps to check
R remade connections after removal of test equipment.

B. Tools and Equipment.

Pressure test and inhibiting rig (PTIR)... ... PE.17988

Pressure test equipment (contained in adapter set PE.29964) are required as follows:

R Air bleed tube PE.22898

R Adapter (Pre S.B.OL.593-73-1 drain valve) PE.22972

R Adapter (S.B.OL.593-73-1 drain valve) ... PE.26710

Blank PE.20757

Blanking unit (2) AS.15826

Blanking plug PE.29937

Clamp PE.27277

Drain adapter PE.20748

R Drain adapter PE.35666

Hose PE.22893

R Drain tube (Pre S.B.OL.593-73-1 drain valve) ... PE.34076

R Drain tube (S.B.OL.593-73-1 drain valve) ... PE.26706

R C. Test Fluid.

R Aviation kerosine D.Eng.R.D.2494
R or
R Inhibiting fluid DEF.2001A
R or
R D.Eng.R.D.2490

R D. Drain the Inlet Section of the System.

R (1) Open bleed valve to expedite draining.

R (2) Use drain tool PE.34076 (Pre S.B.OL.593-73-1 drain
R valve) or PE.26796 (S.B.OL.593-73-1 drain valve) at

CR 31229/00 B

CLAMP
BLANK
FUEL INLET ELBOW
A
B
[A]
DRAIN VALVE
INLET ELBOW DRAIN ADAPTER
ADAPTER SB.73-1
COVER
HOSE ASSEMBLY
SEALING RING
ADAPTER PRE SB.73-1
THROTTLE VALVE ACTUATOR GEARBOX
DRAIN ADAPTER ASSEMBLY (INCORPORATING RELIEF VALVE)
[B]

CMR 76 11 01 5 AAMA

Installation of Test Equipment and Location
(Sheet 1 of 2)
Figure 501

CR 31449/00C

EJECTOR PUMP OUTLET

BLANKING PLUG

FIRST STAGE PUMP

E

BLANKING PLUG

FUEL ATOMIZING PILOT NOZZLE TUBE JUNCTION

F

BLANKING PLUG

CMR 76 11 01 5 AAMB

Installation of Test Equipment and Location
(Sheet 2 of 2)
Figure 501

R

the inlet elbow drain valve. Direct free end of drain tube into a container and drain the system upstream of the fuel heater and filter.

(3) When drain ceases, remove the drain tube and close the bleed valve.

<u>NOTE</u>: Discard drained fuel or inhibiting fluid.

E. Install Pressure Test Equipment.

(1) Carry out the procedures of 73-00-00, Adjustment/Test, paragraph 6.B., as detailed for the installation and removal of the following items of test equipment and engine components respectively.

(a) PE.20757 - blank and PE.27277 - clamp (Ref. Fig. 501) (detail A). Install in fuel inlet elbow.

(b) PE.22893 - hose and PE.22972 - adapter (Pre S.B. OL.593-73-1 drain valve) or PE.26710 adapter (S.B.OL.593-73-1 drain valve) (Ref. Fig. 501) (detail A). Assemble hose and adapter to fuel inlet elbow drain valve location.

(c) PE.29937 - blanking plug (Ref. Fig. 501) (detail E). Install in the return fuel tube at outlet to ejector pump/first stage pump.

(d) PE.35666 - drain adapter (Ref. Fig. 501) (detail B). Install adapter in the throttle valve actuator gearbox spill/drain plug location.

(e) PE.20748 - drain adapter (Ref. Fig. 501) (detail A). Assemble drain adapter to fuel inlet elbow drain connection.

(f) AS.15826 - blanking unit (Ref. Fig. 501) (detail F). Install items on fuel atomizing pilot nozzle tube junction connections.

(2) Direct free ends of drain tubes into a container.

F. Pressure Test Procedure.

(1) Comply with the following general procedure for a pressure test.

(a) Prepare and use the PTIR for the test sequence to be employed in accordance with its general

procedure and safety precautions.

(b) Couple a self-sealing hose of the test rig to the installed test adapter hose at the inlet elbow.

(c) Verify that the weight of the hose is supported and that all connections are secure before commencing test procedure.

(d) Apply pressure slowly and progressively during the test procedure and maintain constant observation for signs of fuel leaks from test equipment or engine fuel system. Should a leak develop, reduce the pressure to zero and stop the pump motor, rectify the fault and recommence the test procedure.

(2) Bleed all air from the system and continue with the low pressure test, paragraph (3).

(a) Operate the test rig and apply a pressure of 30 psig (207 kPa).

R (b) Install air bleed tube PE.22898, open the air
R bleed valve and allow to bleed until an air
R free fuel flow is obtained and then close the
R valve. Allow a short settling period and repeat
R the bleed process to ensure that the second
R stage pump region is air free and again close
R the valve and remove air bleed tube.

(3) Carry out the low pressure test.

R (a) Continue to apply pressure at 30 psig (207 kPa) and complete the low pressure test. Check drains for indication of seal leakage, and ensure that the following conditions are met before commencing the high pressure test.

(i) No leakage from the primary static seals
R is acceptable. If a leak shows from the
R disconnected outlets of the seal failure
R drains system, find defective seal(s) by
R a process of elimination (Ref. para.G).

<u>NOTE</u>: A leak from the fuel inlet elbow drain could be indicative of a defective seal in the inlet elbow blank.

(ii) There should be no spill from the actuator gearbox rear face drain adapter since the relief valve setting of the adapter is higher than the applied pressure.

(4) Continue with a high pressure set.

(a) Operate the test rig and increase the test pressure to 600 psig (4137 kPa).

(b) Apply pressure for at least five minutes and carry out a general external visual examination of the system while continuing to apply pressure. No leaks are acceptable.

(c) Continue to apply pressure and check the disconnected seal failure drains connections for signs of leaks. No leaks are acceptable. If a leak is disclosed, find defective seal(s) by a process of elimination (Ref. para. G).

<u>NOTE</u>: The seal drains connections at the actuator gearbox and fuel inlet elbow are interconnected internally to more than one seal.

(d) If spill from actuator gearbox appears excessive (100 cc/min. maximum acceptable limit) carry out an accurate leak rate check as specified in 73-00-00, Adjustment/Test.

(e) Reduce test pressure to zero and stop pump motor.

(5) On completion of pressure test, drain the fuel system using the test rig facilities and then uncouple the delivery hose. Open the bleed valve to expedite draining.

<u>CAUTION</u>: ENSURE THAT AIR BLEED TUBE IS NOT INSTALLED. FOREIGN PARTICLES COULD BE DRAWN INTO ENGINE FUEL SYSTEM.

G. Procedure to Locate and Rectify a Leak.

(1) Should a leak occur from the actuator gearbox drains connection, locate and rectify the defect by renewal of seal plate or component. Consideration must be given to other seal locations which interconnect internally to this connection.

(a) Remove throttle valve actuator gearbox (Ref.

76-11-01, Removal/Installation).

(b) Position a container to collect spill drainage from throttle valve aperture at base of FCU (up to 100 cc/min).

(c) With test pressure applied observe FCU seal drain ports for signs of leakage.

(i) If leaks are observed at the FCU drain ports, leakage originating from FCU or its connections (Ref.73-21-01, Adjustment/Test).

(ii) If no leaks are observed at the FCU ports, leakage originates from actuator gearbox/FCU seal plate or actuator gearbox.

R H. Remove Test Equipment and Install/Connect Engine Components.

R (1) Carry out the procedures of 73-00-00, Adjustment/Test,
R paragraph 6.D., as detailed for the removal and
R installation of the following items of test equipment
R and engine components respectively.

NOTE: If an engine is to be inhibited; refer to 70-00-07, Inhibiting and Storage and ascertain which items of the installed test equipment will be required for the inhibiting procedure.

R (a) PE.20757 - blank and PE.27277 - clamp ring.
R Remove blank and clamp ring and reconnect the
R aircraft/engine main fuel connection.

R (b) PE.22893 - hose and PE.22972 - adapter (Pre S.B.
R OL.593-73-1 drain valve) or PE.26710 - adapter
R (S.B.OL.593-73-1 drain valve) (Ref. Fig. 501)
R (detail A). Remove hose and adapter and install
R drain valve.

R (c) PE.29937 - blanking plug. Remove plug and
R install blanking ferrule at ejector pump.

R (d) PE.35666 - drain adapter. Remove adapter and
R install the blanking plug in the actuator gear-
R box.

R (e) AS.15826 - blanking units. Remove the blanks
R and connect fuel atomizing pilot nozzle tubes

to the tube junction.

(2) Carry out a final leak check.

(a) Remove the safety clips and reset circuit breakers. (Ref.76-11-01, Removal/Installation, Table 401).

(b) Ensure that all fuel connections are secure, open the LP fuel valve and start the appropriate aircraft fuel feed pumps.

(c) Install air bleed tube PE.22898, open the air bleed valve and bleed all air from the system. When fuel flows free of air, close the bleed valve and torque-tighten to between 100 and 110 lbf in. (11,3 and 12,4 N.m) with lubricant A applied. Remove bleed tube.

(d) With feed pump pressure applied, check for signs of leakage at bleed valve, drain valves, blanking ferrules and the drains outlet of the aircraft/ engine connections under test. No leaks are acceptable.

(e) On completion of check, switch off the aircraft feed pumps.

(3) PE.20748 - drain adapter. Remove drain adapter from inlet elbow and connect the seal drains system as detailed in 73-00-00, Adjustment/Test, paragraph 6.D.

(4) Ensure that seal is in place and assemble the dust cap to the air bleed valve. Tighten the cap and wire-lock it.

(5) Assemble pressure cap with new seal to the fuel inlet elbow drain valve. Tighten the cap and wire-lock it.

(6) Complete the procedure as detailed in 76-11-01, Removal/Installation.

ENGINE CONTROL AMPLIFIER - DESCRIPTION AND OPERATION

1. General

The primary function of the control amplifier is to compute an output signal to drive the engine fuel control throttle in response to pilot's demand input signals and modifying engine parameter signals and give the engine power setting demanded. A secondary function of the control amplifier is to generate an output signal to the trim unit of the pneumatically operated primary nozzle control system and set the nozzle area for optimum engine performance.

The computation is a continuous process and the pilot's lever is, in effect, a power lever that gives the pilot the maximum power available at any particular lever setting with the engine limitations and the prevailing environmental conditions taken into account.

2. Description

The control amplifier, shown in 76-10-00, (Ref. Fig. 004), is housed in an 0.5 ATR (long) case, measures 8.15 in. (207 mm) high, 4.9 in. (124 mm) wide and 21.3 in. (541 mm) deep and weighs 26 lb. (11.8 kg). At the front are two carrying handles each incorporating a latch to retain the unit in its rack when installed.

The front panel carries two test sockets, shielded by protective caps, for use in conjunction with a ground test set. The lower socket cap contains wired-in links and must not be removed except for testing purposes. A hinged, wire-locked panel allows access to a group of preset potentiometers. Also on the front panel and located below the potentiometer panel is an elapsed time meter which records the length of time for which the amplifier has been energized.

At the rear of the amplifier case there are three, 57-way plugs for electrical connection. These mate with corresponding sockets in the rack when the amplifier is secured in place.

The major structural part of the amplifier is formed by a fabricated, box-section chassis with detachable side plates. Within the chassis there are 22 double-sided, printed circuit module boards, a power supply unit, relays, preset potentiometers and a radio suppression unit. Several other printed circuit boards are used to distribute certain common supplies and signals. The 22 circuit module boards are plugged into 62-way edge connector sockets which carry the input/output signals and power supplies.

The amplifier operates on 28 V d.c. and 115 V, 400 Hz, single phase a.c. power supplies.

3. Operation

A. General.

When effective in control in an engine power control system, a control amplifier acts in response to input signals and transmits controlling outputs (Ref. Fig. 001). One output adjusts fuel flow to meet the power demand within the operations limiting parameters. The other output adjusts primary nozzle area to achieve the N1/N2 speed relationship that gives optimum engine performance for the operating condition. The engine control system operation is described in 76-10-00.

There are three control loops in the amplifier which are effective in control of fuel flow:

an HP rotor assembly rpm, N2, governing loop;
a throttle valve positioning loop and,
a non-dimensional rpm, N2/root theta governing loop.

The input signals to the amplifier for these control loops are:

Governing and positioning from pilots throttle lever transmitter.
HP rotor assembly speed, N2.
Throttle valve actuator gearbox position and velocity
Intake total air temperature, T1.
Exhaust gas temperature, EGT.
Freestream total air pressure, P infinity.
Ambient temperature, t alpha.

The control loops cover the full range of engine operation with only one loop effective in control at any time. In addition to the basic loops, there are limiting networks and logic circuits which modify or inhibit the control loop signal to ensure that the engine operates smoothly and within safe limits. The operating limits include a maximum N2 limitation which is directly referenced, a maximum N1 limitation, and a maximum turbine entry temperature limitation which is referenced to intake air temperature, T1, and exhaust gas temperature, EGT.

The N1/N2 relationship is maintained by control of N1 in respect of N2 by the E schedule. The schedule acts in response to input signals of N1, N2 and T1 and establishes

CR 34637/008

PILOTS THROTTLE LEVER TRANSMITTER
POSITION SIGNAL
GOVERNOR SIGNAL
ENGINE RATING SELECTOR
CLIMB. CRUISE
CONTINGENCY OR TAKE-OFF
ENGINE CONTROL SCHEDULE SELECTOR
GROUND IDLE SWITCH
TAKE-OFF N1 LIMITER SWITCH (No4 ENG. ONLY)
DE-BOW SWITCH
AUTO N1 √θ REDUCE
FREE STREAM TOTAL AIR PRESSURE
REVERSE BUCKET FAILURE
REHEAT
REVERSE THRUST
RELIGHT
AUTO IGNITION
POWER SUPPLIES
28V DC
115V AC

ENGINE CONTROL AMPLIFIER

N2
N1
T1
EGT (Tj)
ACTUATOR GEARBOX (TV)
ACTUATOR CONTROL SIGNAL
ACTUATOR POSITION AND VELOCITY FEEDBACK SIGNALS
NOZZLE TRIM ACTUATOR
ACTUATOR CONTROL SIGNAL
ACTUATOR POSITION AND VELOCITY FEEDBACK SIGNALS
INDICATION
RELIGHT TO IGNITER CIRCUITS
REHEAT FUEL CONTROL UNIT SIGNAL (FUNCTION OF T1)

CMR 76 11 11 0 AAMO

Input and Output Signals to Control Amplifier
Figure 001

the engine running line for the specific operating condition.

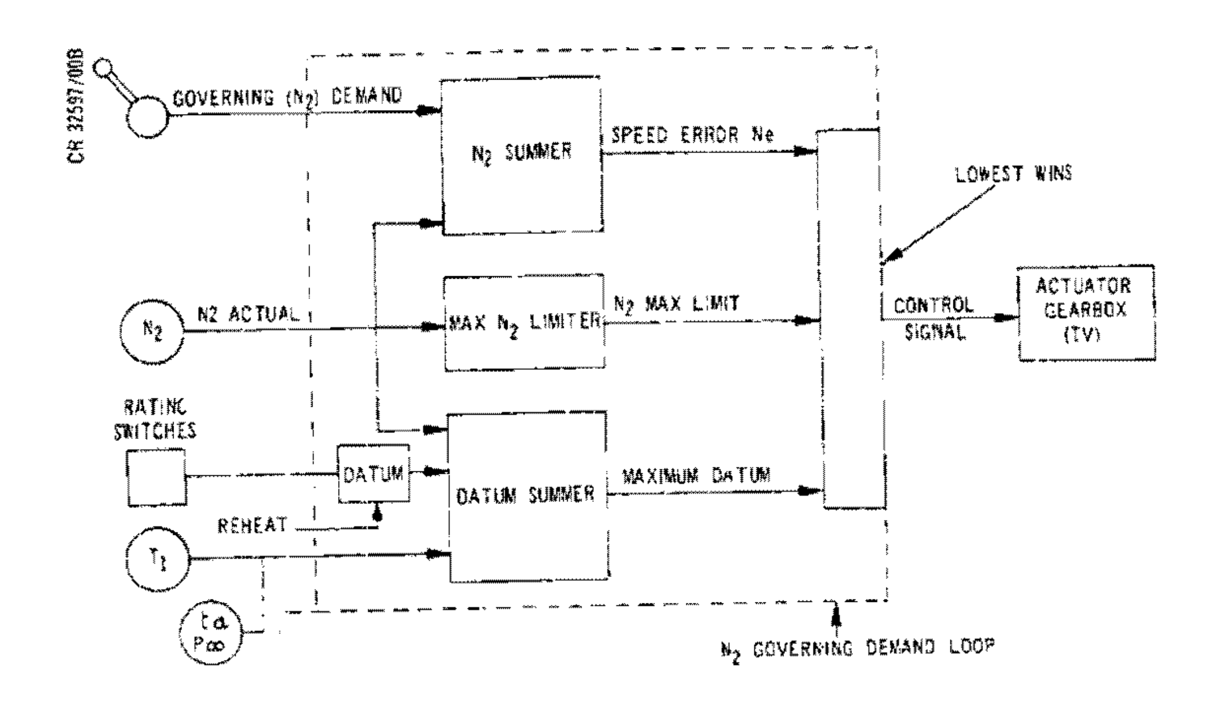
B. Governing Demand Loop (Ref. Fig. 002)

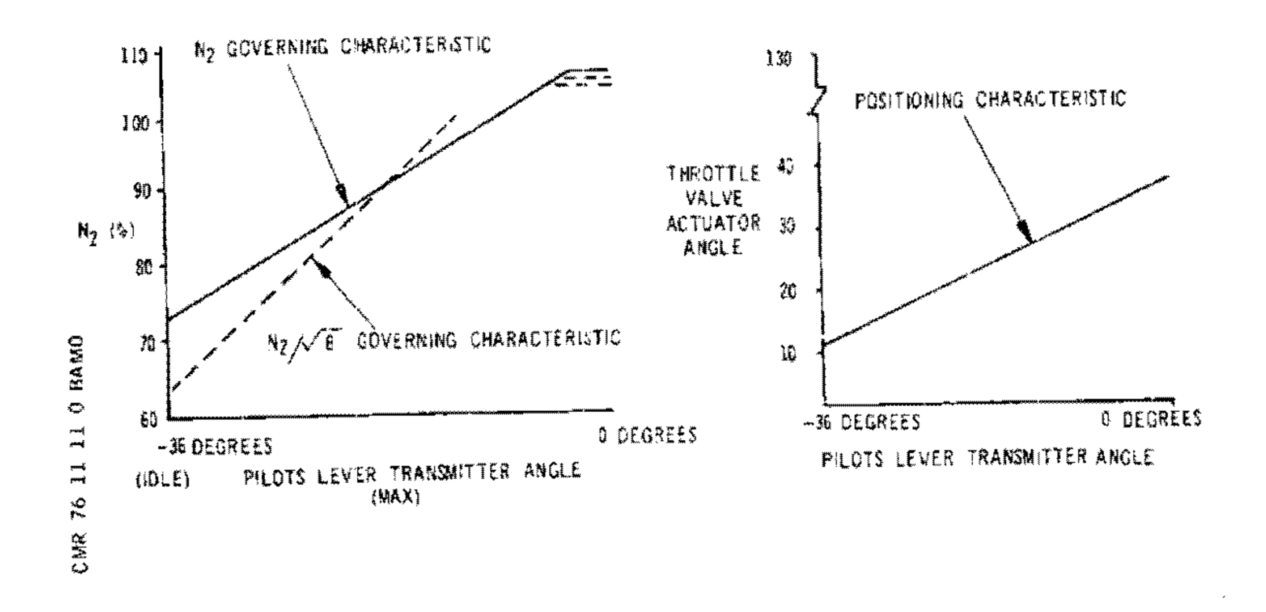
In the N2 governor loop, the N2 demand signal is compared with the actual N2 signal. Whenever the actual and demanded N2 differ, a speed error signal Ne will occur and, provided no limiting signals are effective, will result in a control signal output. This control signal will be in the sense to adjust the fuel flow, and consequently N2, until the actual and demanded N2 are the same. Once the demanded N2 is achieved, the speed error signal ceases and a steady state condition is established. The governing loop maintains a demanded N2 constant by regulation of the fuel flow.

A change in power demand alters the demanded N2 signal and disturbs the steady state condition. The resulting speed error signal is in a sense to restore the balance at a higher or lower N2 that will meet the new power demand. The engine HP rotor assembly rpm can be increased in response to demand until a limiting control is invoked by either the maximum N2 limiter or the engine rating datum. These two limiting outputs, together with the power demand error signal, are compared by the governor loop and the signal that demands the lowest N2 is transmitted as the effective control signal.

A limiting control in the governing demand loop is necessary to cater for two major factors that affect engine life, the turbine entry temperature and the maximum engine rotational speed. An additional limiting control circuit to prevent excessive turbine entry temperature is described in paragraph F. The operational limits imposed will ensure that turbine blade creep is kept within acceptable limits and give maximum turbine life commensurate with performance.

In any selected engine rating, a maximum datum signal demands an N2 that holds the turbine entry temperature within a required operational limit while the maximum N2 limit signal demands the N2 that is the maximum acceptable HP rotor speed. Should a demand for an N2 higher than either or both of the two limiting signals be imposed, then the signal with the lowest N2 demand is made effective in control by a lowest wins network. The engine accelerates until the actual N2 balances this effective control signal and a steady state condition ensues. The other two signals could still be demanding an increase in N2 but the lowest wins network renders them





N2 Governing Demand Loop and Control Characteristics
Figure 002

ineffective.

The value of the maximum N2 datum signal to be imposed is determined by the following factors:

The selected engine rating of either contingency, take-off, climb or cruise.

The total air temperature, T1, at the engine face.

The ambient temperature, t alpha, from the air data computer (ADC) via the nozzle angle scheduling unit (NASU).

The total free-stream air pressure, P infinity, from the air intake control system.

The reheat selection.

The value of N2 for any selected datum is controlled as a function of T1 with the signal modified in respect of t alpha and P infinity. These relationships are shown in (Ref. Fig. 003) which also shows the flight A, B and C schedules which are used for the climb or cruise ratings. The signal modification by t alpha is necessary because the thrust produced by the engine in the cruise rating becomes greater than required at very low ambient temperatures. With reheat off, the maximum N2 datum is progressively reduced as t alpha decreases. The maximum N2 signal is modified in respect of changes in P infinity because the effective N2 for any selected datum decreases as P infinity decreases.

The effective datum schedules for the various engine rating selections are shown in Table 1. When the engine is operating with a rating selection CLIMB and reheat is on, then the schedule will change to flight B if T1 is above 353 deg K. With CRUISE selected and reheat off, operation is progressively changed from the flight B schedule to the flight C schedule as t alpha decreases from 221.7 deg K to 206.7 deg K.

Rating Switch Selection	Reheat	Schedule
CTY (Contingency)	ON	Contingency
TAKE-OFF	ON or OFF	Take-off
CLIMB	ON	Flight A
	(or when T1 is greater than	Flight B

Rating Switch Selection	Reheat	Schedule
	353 deg K)	
CLIMB	OFF	Flight B
CRUISE	ON	Flight B
CRUISE	OFF	Flight B or C

Rating Selections and Effective Schedules
Table 1

The engine rating selections are also effective on the maximum exhaust gas temperature datum schedules described in paragraph F.

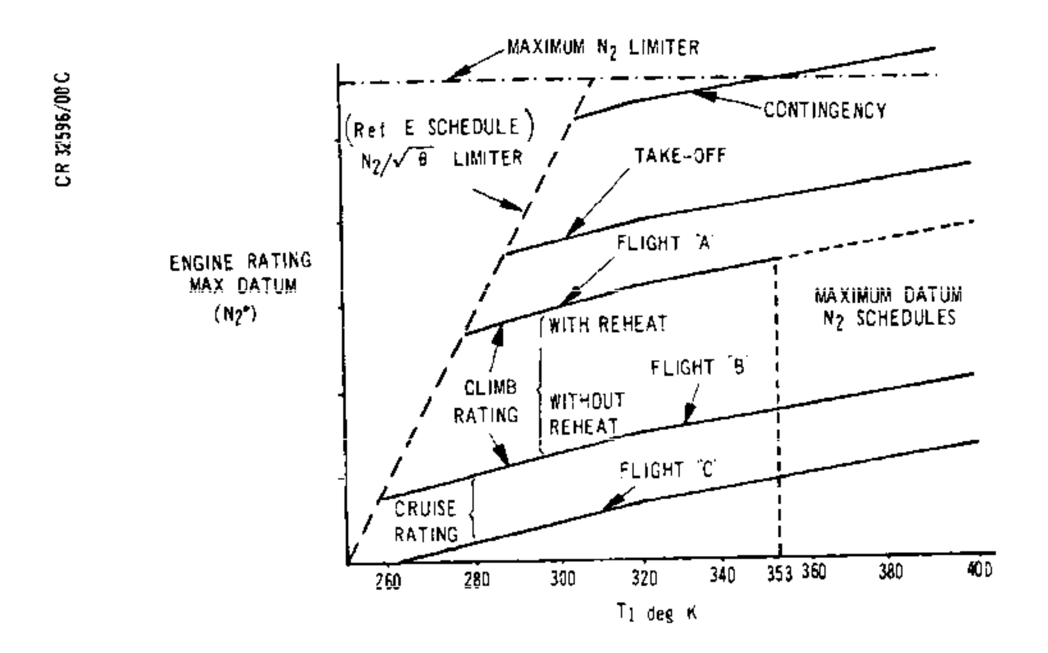
C. Positioning Demand Loop.

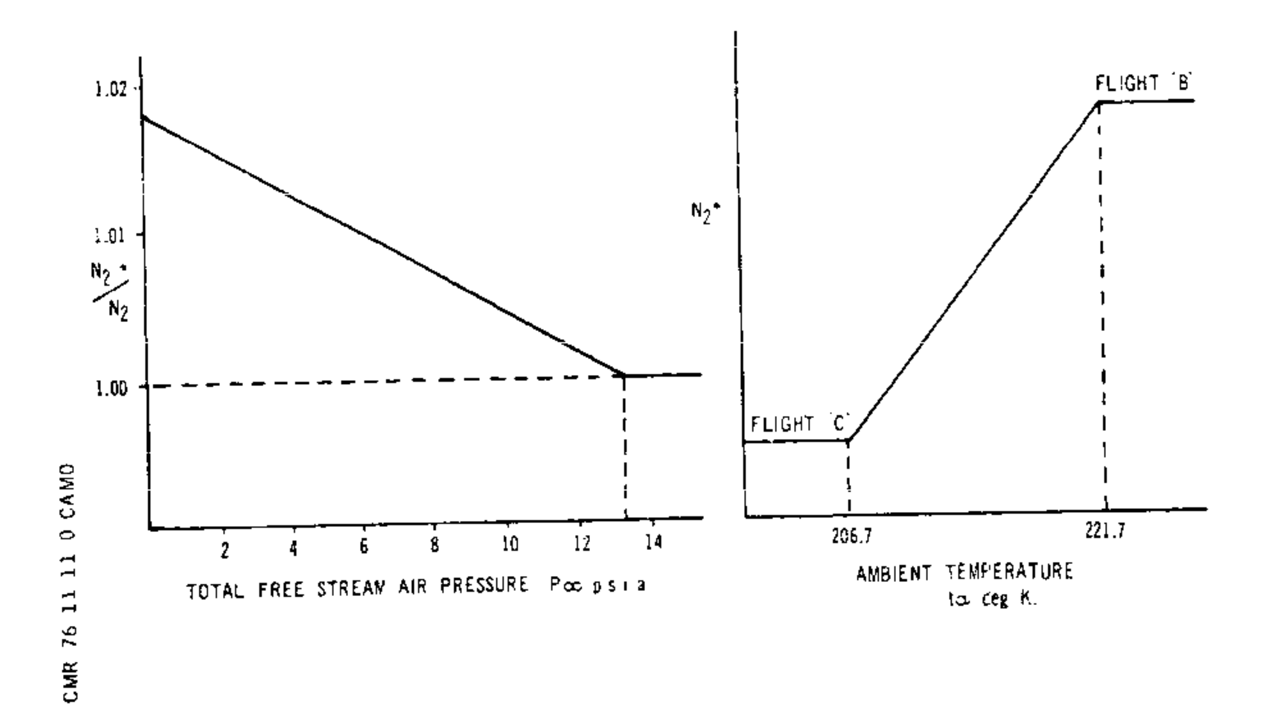
In the positioning loop, the pilot's lever setting determines the position demand signal transmitted to the control amplifier. The synchro transmitter in the actuator gearbox transmits a feedback signal, of a value relative to the throttle valve position, to the control amplifier. If the engine is operating in the positioning range, the throttle valve setting will be directly related to the throttle lever setting with the two signals in balance. Since the throttle valve setting is fixed by the lever position, the fuel flow rate is maintained constant and N2 will vary in response to changes in the ambient conditions increasing with increase in altitude. The positioning characteristic is shown in (Ref. Fig. 002).

Throttle lever movement results in a difference between the position demand and position feedback signals and a position error signals occurs. While the positioning demand loop is effective in control, a control signal will act in a sense to drive the actuator and bring the signals into balance with the throttle valve in the position demanded by the pilot's lever.

D. N2/root Theta Governing Demand Loop.

The N2/root theta governing loop is effective in control of thrust in the low power range as shown by the characteristic in (Ref. Fig. 002). A reference signal, N2/root theta, is derived by the control amplifier from an actual N2 signal and a T1 signal.





Engine N2 Datum Schedules
Figure 003

The demand signal is compared with the reference N2/root theta value. With a set throttle lever position, any change in air total temperature T1 will result in a difference between the two signals and give rise to an error signal. In response, a control signal output would be generated in a sense to correct the error. This would result in a change of the engine speed until the actual N2 value conformed to the existing T1 value and restored the N2/root theta balance with a re-established steady state condition.

A demand signal change would result in an error signal with a regulation of the fuel flow, and consequently N2, to establish the steady state condition that meets the new demand.

A limit is imposed on the minimum engine speed when this control loop is effective in control as described in paragraph F, minimum idle N2 datum.

E. Pilot's Demand Logic (Ref. Fig.002 and 004)

Although the three basic control loops are continuously activated only one can be effective in control at any time. Three factors dictate the choice of the control loop to be made effective in regulating the throttle valve.

Control at high power settings must always be by an N2 governing system.

At altitude, the fuel flow must be prevented from reducing to the point where flame extinction could occur.

At ground level, idle rpm must be as low as possible within rotating stall limitation.

The error signals from the N2 and N2/root theta governing demand loops are fed to the lowest wins network which transmits the signal demanding the lowest N2 to the highest wins network. In this network the signal is compared with the error signal emanating from the positioning demand loop. The signal demanding the highest N2 is selected to be the effective control signal to drive the throttle valve actuator gearbox motor.

While the engine operating condition meets the demand of the effective control loop, there will be no control signal transmitted to the actuator gearbox, the throttle

value setting will be maintained and a steady state condition will exist. A change in power demand or a change in operating or ambient conditions, would upset the state of balance in the control loops. The resulting change in the error signals would necessitate regulation of the throttle valve to establish a steady state condition. With this change of values, there could also be a change of effective control loop. The three control loop characteristics, showing N2 in percentage for a given angle of pilot's lever transmitter pick-off, are shown for three conditions of operation in (Ref. Fig. 004).

In the first condition, the loop characteristics are for ISA sea level with the aircraft static. In order to obtain the required engine condition during an acceleration, the engine operating line follows the N2/root theta control line from idle to point A and the N2 governor control line to the maximum N2 datum line. This sequence of control is obtained in the following manner:

The N2 obtained from the N2 and N2/root theta governing loops for any given pilots lever pick-off angle are compared and the loop demanding the lower N2, is selected.

The N2 obtained from this loop (in para.1) is compared with the N2 demanded by the positioning loop for the same pick-off angle and the loop demanding the higher N2, is allowed to control.

When the aircraft is at M. 0.9 at 30000 ft in ISA condition the characteristics show that, due to the increase in altitude to 30000 ft, the N2 obtained for a given pick-off angle by the positioning loop has increased due to the demand being for a fixed fuel flow. Also due to T1 decreasing to 265 deg K, the N2 obtained from the N2/root theta control has proportionally decreased. The engine operating line now follows the positioning control line to point B, N2/root theta governing control line to point C and finally, the N2 governing control line up to maximum rpm.

The required engine condition is again obtained by selecting the desired control loop in the same manner as for the first condition of operation.

The loop demanding the lower N2 between the two governing loops (N2 or N2/root theta) is selected.

This loop is then compared with the positioning loop and the loop demanding the higher N2 is used for

CR 32595/00B

POSITION FEEDBACK SIGNAL

ERROR CONTROL SIGNAL

POSITIONING DEMAND LOOP

EFFECTIVE CONTROL SIGNAL

POSITIONING DEMAND

N_2 ACTUAL

LOWEST WINS

N_2 DEMAND

P

N_2 GOVERNING DEMAND LOOP

ACTUATOR GEARBOX (TV)

N_2

T_1 RATING P_∞ t_a REHEAT

$\frac{N_2}{\sqrt{\theta}}$ GOVERNING DEMAND LOOP

THROTTLE VALVE

T_1

HIGHEST WINS

ERROR CONTROL SIGNAL

$\frac{N_2}{\sqrt{\theta}}$ DEMAND

61% MINIMUM DATUM

PILOTS DEMAND LOOP LOGIC

100 90 80 70 60

N_2%

A

I.S.A. SEA LEVEL - STATIC (T_1 = 288° K)

-36 DEGREES PILOTS LEVER TRANSMITTER ANGLE 0 DEGREES

100 90 80 70 60

N_2%

C

B

M0.9 30.000 FT. I.S.A. (T_1 = 265° K)

-36 DEGREES PILOTS LEVER TRANSMITTER ANGLE 0 DEGREES

CMR 76 11 11 0 DAMO

100 90 80 70

N_2%

D

M2.05 50.000 FT I.S.A. (T_1 = 397° K)

-36 DEGREES PILOTS LEVER TRANSMITTER ANGLE 0 DEGREES

KEY

ENGINE OPERATING LINE

POSITIONING CHARACTERISTIC

N_2 GOVERNING CHARACTERISTIC

$\frac{N_2}{\sqrt{\theta}}$ GOVERNING CHARACTERISTIC

N_2 CONTROL CHARACTERISTICS

Pilots Demand Loop and Characteristics
Figure 004

control.

The loop characteristics for the aircraft cruise condition of M. 2.05 at 50000 ft at ISA conditions show that N2 obtained from the positioning control loop will have increased, for a given pilots demand, due to the further increase in altitude. This time the N2.root theta will have increased considerably, due to the increase in T1 to 397°K. Applying the same logic as in the two previous cases, the engine operating line will follow the positioning control line from idle to point D and the N2 governing control line thereafter.

By the application of a simple logical comparison of loop demands, all the required engine conditions can be satisfied, in all phases of flight.

F. Engine Operation Limiting Networks.

The control loops permit the pilot to use the throttle lever to make any desired power demand within the maximum rpm limit determined by the selections made on the rating switches. Although a rapid response is required, limiting and control circuits are needed to modify the demand signal and prevent any safe limit of engine operation being exceeded. Each limiting factor overrides the power demand signal and acts automatically in either the engine starting phase, debow control, minimum idle limitation and acceleration and temperature limitation; as described in the following paragraphs and (Ref. Fig. 005). The electrical control system also includes control for functions other than power demand.

Debow control:

In certain conditions of engine starting, the engine must be held at a low rpm for a period before acceleration to idle. Selection of the debow network generates a signal to the lowest wins network that overrides the pilots demand signal and restricts N2 to approximately 30%. When the required time has elapsed, selection of the switch cancels the limiting signal and allows normal acceleration to idle rpm.

To prevent inadvertent selection of the debow network winding the engine down to 30% N2 during engine operation, the debow signal is inhibited when N2/root theta exceeds 58%.

Starting phase:

RATING SWITCH
DATUM
t_a T_1 P_∞
REHEAT
P
POSITIONING DEMAND LOOP
N_2 GOVERNING DEMAND LOOP
$N_2/\sqrt{\theta}$ GOVERNING DEMAND LOOP
HIGHEST WINS
LOWEST WINS
N_2
T_1
$N_2/\sqrt{\theta}$
61% MINIMUM DATUM
DECELERATION CONTROL
67/58% $N_2/\sqrt{\theta}$
LOWEST WINS
DE-BOW SWITCH
DE-BOW CONTROL LOOP-30% N_2
<58% $N_2/\sqrt{\theta}$
ACTUATOR GEARBOX (TV)
33° SWITCH
67% $N_2/\sqrt{\theta}$
START CONTROL SCHEDULE
67/58% $N_2/\sqrt{\theta}$
P_∞
t_a
ACCELERATION CONTROL
REHEAT
DATUM
MAXIMUM TEMPERATURE CONTROL
EGT
RATE OF RISE OF TEMPERATURE CONTROL
THROTTLE VALVE

CONTROL LIMITATION

CR 32593/000

ACCELERATION (RATE - DEGREES OF THROTTLE ACTUATOR ANGLE PER SECOND)
16
14
12
10
8
6 8 10 12 14
TOTAL FREESTREAM AIR PRESSURE
P_∞ psia

ACCELERATION RATE CONTROL

CONTINGENCY
TAKE-OFF
FLIGHT A
EGT
CLIMB RATING
FLIGHT B
CRUISE RATING
FLIGHT C
260 280 300 320 340 360 380 400
T_1 IN DEGREES KELVIN (K)

FLIGHT B
EGT
FLIGHT C
206.7 221.7
AMBIENT TEMPERATURE t_a deg K

EGT MAXIMUM DATUM SCHEDULES

CMR 76 11 11 0 LAMO

Limiting Networks and Control Schedules
Figure 005

The limiting controls effective during the engine starting phase are:

The debow control
The 67/58% N2/root theta switch
The start control schedule
The minimum idle N2 datum
A lower rate of temperature rise control for starting and relighting

The start control schedule, illustrated in (Ref. Fig. 006) is used to ensure that the correct fuel/air ratio for starting is obtained. When the engine is at rest prior to starting, there is no actual N2 signal and the demand signal is dominant in the governing control loops. A 67/58% N2/root theta switch mutes this control demand signal and makes the schedule effective until N2/root theta reaches 67%. The muting becomes non-effective once this speed is reached and the demand loops assume control. When the N2/root theta reaches 58% during engine deceleration, the switch will again mute the control demand signal and make the start schedule effective in control.

The start schedule is reference to N2/root theta and controls the throttle valve to provide a maximum fuel flow in accordance with this datum. The output from the start schedule is taken to a lowest wins network and, in comparison with the other demand signals, limits the maximum fuel flow obtainable. To improve the fuel/air ratio for altitude relighting, the start schedule is modified as a function of the total free-stream air pressure, P infinity to reduce the throttle valve setting, and consequently fuel flow, as P infinity decreases. To prevent the start schedule affecting normal acceleration, the schedule is inhibited by a minus 33 degree switch when the pilots lever transmitter is between minus 33 and 0 degress and is demanding a higher rpm than idle.

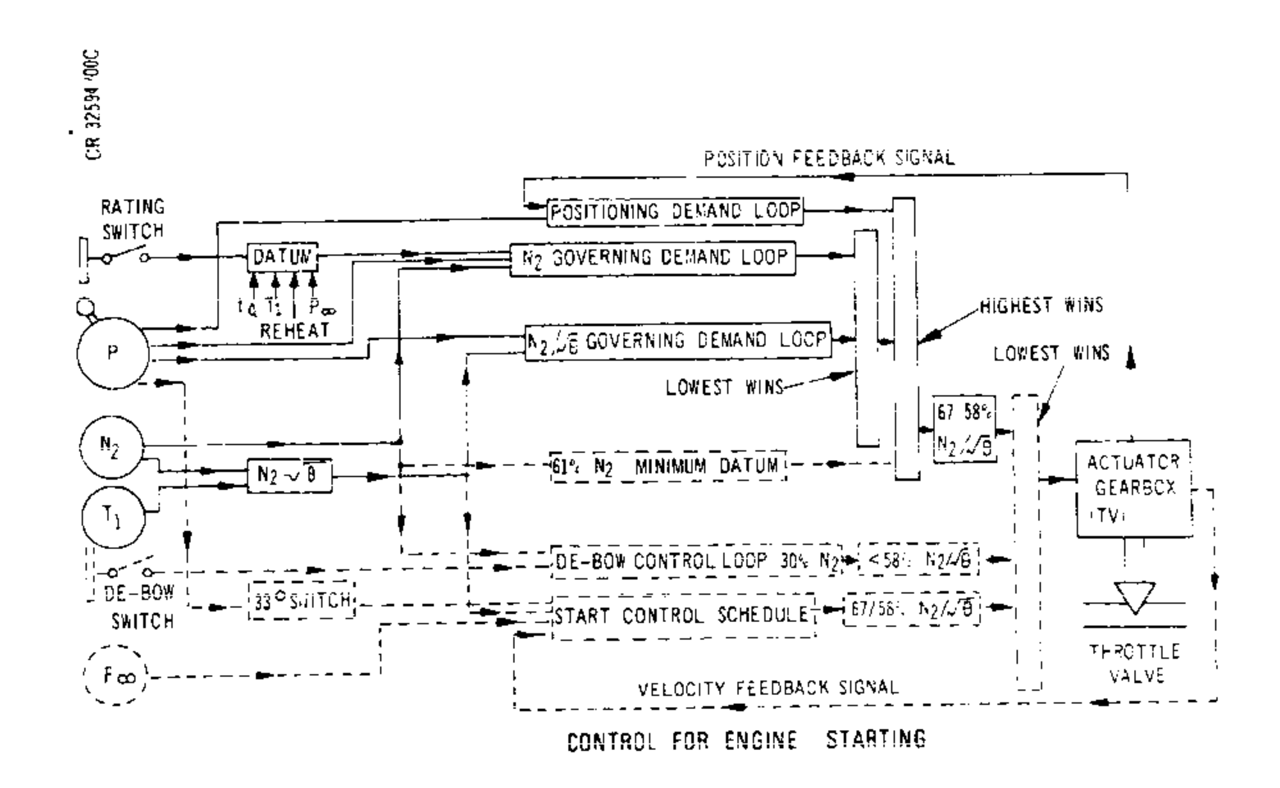
While the start schedule is effective, a lower rate of temperature rise datum is imposed on the limiting control for the engine starting and relight phases.

Minimum idle N2 datum:

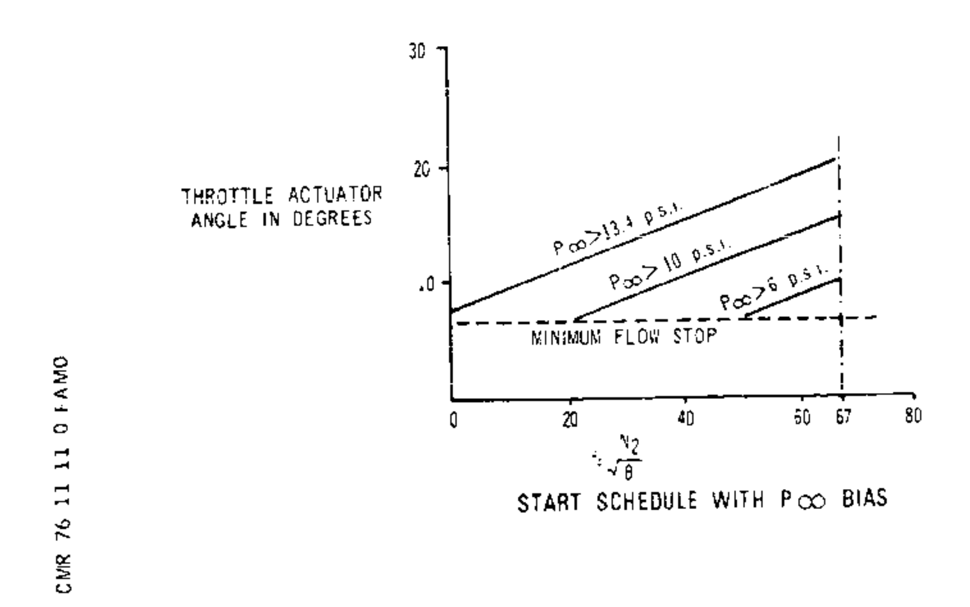
In very low T1 conditions, the idle rpm is governed to an N2/root theta value and the equivalent N2 could fall too low. A signal passed to the highest wins network demanding a minimum N2 of 61% prevents this.

Acceleration rate control:

CR 32594 '00C



CONTROL FOR ENGINE STARTING



START SCHEDULE WITH P∞ BIAS

CMR 76 11 11 0 FAMO

Starting Control and Schedule
Figure 006

The rate of throttle actuator angular movement in degrees per second is scheduled against changed in free-stream total air pressure, P infinity. At P infinity greater than 13.4 psi, the rate is 15 deg/sec, progressively reducing with reduction in P infinity to a minimum value of 8 deg/sec. A computed schedule signal demanding a throttle opening at the maximum acceleration rate limit is passed to the lowest wins network where it is compared with the demand signal. The signal demanding the lowest rate of acceleration will be made effective in control and ensures that the engine accelerates within a safe range and does not become liable to surge.

Deceleration rate control:

The deceleration rate control circuit passes a signal, of a throttle closing sense, to the highest wins logic to be compared with the demand signal. The control signal demanding the lowest rate of reduction of fuel flow will be made effective in control and thus the rate of deceleration will be limited.

Rate of temperature rise control:

A monitored sensing signal in respect of exhaust gas temperature, EGT, is transmitted to the control amplifier. The actual rate of rise is compared with a permitted rate of rise datum and generates an output signal that is a function of the error between the two signals. This output signal modifies or overrides the demand signal as necessary. If the rate of temperature rise is at datum, the signal will prevent the throttle valve opening any more thereby controlling the rate of rise. If the rate of rise exceeds datum, the control signal will move the throttle towards the closed position and, in reducing the fuel flow, will reduce the rate of rise back to the maximum permitted.

Operation of the minus 33 degree switch ensures that, when the pilots lever is selected to idle, a lower rate of temperature rise is established for engine starting or relighting.

Maximum temperature control:

A maximum temperature control is referenced to exhaust gas temperature, EGT, and intake air temperature, T1. The transmitted signal is compared with a maximum temperature datum in the control amplifier. The resulting output will be the error between the actual and datum temperature signals and, should the actual temperature approach datum,

the control signal will override the demand signal and reduce the rate of adding fuel. If the actual temperature should reach or exceed the datum, the control signal will override the demand signal and either prevent the throttle opening or close it and thereby bring the temperature back to datum.

The maximum temperature of the EGT datum in operation is determined by a datum unit, within which are five datums. The required datum is selected by rating and reheat selection switches. The schedules used with these selections are given in Table 1. The flight A, B and C schedules are used in conjunction with the climb and cruise selections. Also, with CRUISE selected and reheat off, operation is progressively changed from flight B schedule to flight C schedule, as the ambient temperature, t alpha, falls from 221.7 deg K to 206.7 deg K.

A start datum is selected automatically when N2/root theta is less than 67% and is the effective datum for the starting and relight phases.

N2/root theta limiter:

In order to obtain the optimum engine performance and maintain adequate surge margin, a maximum N2/root theta limiter, and an E3 schedule, is incorporated. Should the N2/root theta reach this value, a signal is passed to the fuel control network to control fuel flow and so prevent the limiting value being exceeded.

N1/root theta limiter:

In order to obtain the optimum engine performance and maintain adequate surge margin, an N1/root theta limiter is included. When the limiting value of N1/root theta is reached, a signal is passed to a lowest wins network in the nozzle control network. The control of the primary nozzle is then such that the limiting value is not exceeded.

G. Ancillary Control Functions.

The control amplifier includes the following control functions to meet specific conditions of engine operation other than in the normal propulsion power control phase. The limiting and control schedules are shown in (Ref. Fig. 007).

Relight during flight:

INTENTIONALLY BLANK

FLIGHT REVERSE THRUST (PROPPED IDLE) SWITCH

RATING SWITCH

PILOTS LEVER

P

DATUM

t_0 T_1 $P\infty$

REHEAT

POSITIONING DEMAND LOOP

N_2 GOVERNING DEMAND LOOP

$N_2/\sqrt{\theta}$ GOVERNING DEMAND LOOP

REVERSE THRUST $N_2/\sqrt{\theta}$ SCHEDULE

61% N_2 MINIMUM DATUM

DECELERATION CONTROL

LOWEST WINS

HIGHEST WINS

POSITION FEEDBACK SIGNAL

N_2

T_1

$N_2/\sqrt{\theta}$

CR 32592/00C

DEBOW SWITCH

RELIGHT SWITCH

DE-BOW CONTROL LOOP-30% N_2

< 58 % $N_2/\sqrt{\theta}$

33° SWITCH

IGNITION CONTROL

START CONTROL SCHEDULE

67/58 % $N_2/\sqrt{\theta}$

67% $N_2/\sqrt{\theta}$

$P\infty$

t_0

ACCELERATION CONTROL

LOWEST WINS

ACTUATOR GEARBOX (TV)

REHEAT

DATUM

EGT

MAXIMUM TEMPERATURE CONTROL

RATE OF RISE OF TEMPERATURE CONTROL

VELOCITY FEEDBACK SIGNAL

AUTO IGNITION SWITCH

AUTO-IGNITION CONTROL

IGNITION

> 67% $N/\sqrt{\theta}$

REVERSE THRUST REFERENCE SIGNAL

WIND-DOWN CONTROL

PRIMARY NOZZLE

CMR 76 11 11 0 GAMO

N2 Limiting and Control Schedules
Figure 007

When relighting an engine, it is essential that the fuel/air ratio is correct before ignition is initiated. When relight is selected, the relight signal is fed, via the 33 degree switch, to the ignition control circuit. The 33 degree switch is made when the pilots lever transmitter is at, or just above, the idle setting so that ignition can only be initiated with the throttle valve at idle. Fuel flow for relighting is under the control of the start schedule in the same manner as for the normal starting phase.

Auto-ignition control:

To ensure that a flame out period is minimal, an automatic relight facility can be selected. Selection of this facility makes a monitoring and auto-ignition system effective. Should a flame out be detected, the system will correct the fuel flow and primary nozzle area setting and then initiate the ignition for light-up. When the engine has relit and is operating, the system cancels its control signals and resumes the monitoring role.

Reverse thrust N2/root theta governing:

When reverse thrust is in operation, a reverse thrust N2/root theta schedule is used to override the forward thrust demand loops and control engine rpm as a function of reverse thrust lever position. In addition to the throttle valve control for reverse thrust, a control is imposed on the primary nozzle as described in paragraph 4. Operation of the twin secondary nozzle bucket control system is described in 78-00-00.

Wind-down:

If the twin secondary nozzle buckets move away from their selected positions, in either forward or reverse thrust with power settings above idle, engine power must be reduced to a minimum as quickly as possible. An automatic wind-down circuit is armed by the operation of switches in either the forward or the reverse thrust switch packs and activated by switches in the bucket position indicator unit.

The forward thrust switch contact is made when the pilots throttle lever is in the range from just above idle and arms the bucket position indicator unit switch that acts in 42 to 73 degree movement range of the buckets. The reverse thrust switch contact is made when the reverse thrust lever is beyond the reverse baulk position and arms the bucket position indicator unit switch that acts

in the 0 to 71 degree movement range of the bucket.

While the buckets operate in the desired range selected by the throttle lever or reverse thrust lever, whichever switch has been armed will render the wind-down circuit inoperative. Should the buckets move out of the range, then the switch will make contact, the wind-down circuit be activated and a signal in a throttle closing sense will override all other demand signals and close the throttle valve down to a predetermined fuel flow. The throttle valve is then clamped in the low fuel flow setting.

During this rapid deceleration phase, the rotor assembly speed relationship, N1/N2, must be maintained. At the same time as the wind-down signal actuates the throttle valve, a signal, in a closing sense, is passed to the primary nozzle control network. This signal is effective in control until N2/root theta is reduced to 67%.

Propped idle for reverse thrust in flight:

When the propped idle circuits of No.1 and No.4 engine control are armed and reverse thrust is selected for No.2 and No.3 engines, the propped idle control on No.1 and No.4 engines becomes effective. A signal is then fed to the positioning demand loop that requires an increase in fuel flow and rpm. The enhanced air pressure resulting from the propped idle setting powers the bucket jacks and the buckets move to the reverse position. When movement is completed the propped idle signal is nullified and the throttle valve is again under normal positioning control.

4. Operation of the E Schedule - Control of N1

A. General.

The basic E schedule, shown in (Ref. Fig. 008), consists of three engine running lines E6, E1 and E4 and relates to an engine control schedule switch selection of E high. The E high control gives the best engine performance for cruise conditions. Other E schedules, E2, E5 and E7, are used to impose control schedules to comply with the requirements of other aircraft flight conditions, reheat operation and noise abatement. Limiting networks are used to ensure that the PNC control keeps the engine running within safe operating limits.

The switch control functions and the E schedule running lines that are made effective in control by the switches are shown in (Ref. Fig. 009) and described in paragraph

D.

B. Basic E Schedule.

Input signals N1, N2 and T1, are computed to provide an N1/root theta and an N2/root theta to the E schedule network. This network uses N2/root theta as a datum and compares the actual N1/root theta value with that demanded by the E schedule. Any difference in value generates an error signal in a sense to drive the PNC trim unit to adjust the primary nozzle area until the actual N1/root theta system is in balance with the desired N1/root theta signal and the error signal is cancelled. In this steady state condition, the engine would be complying with the basic E schedule running line.

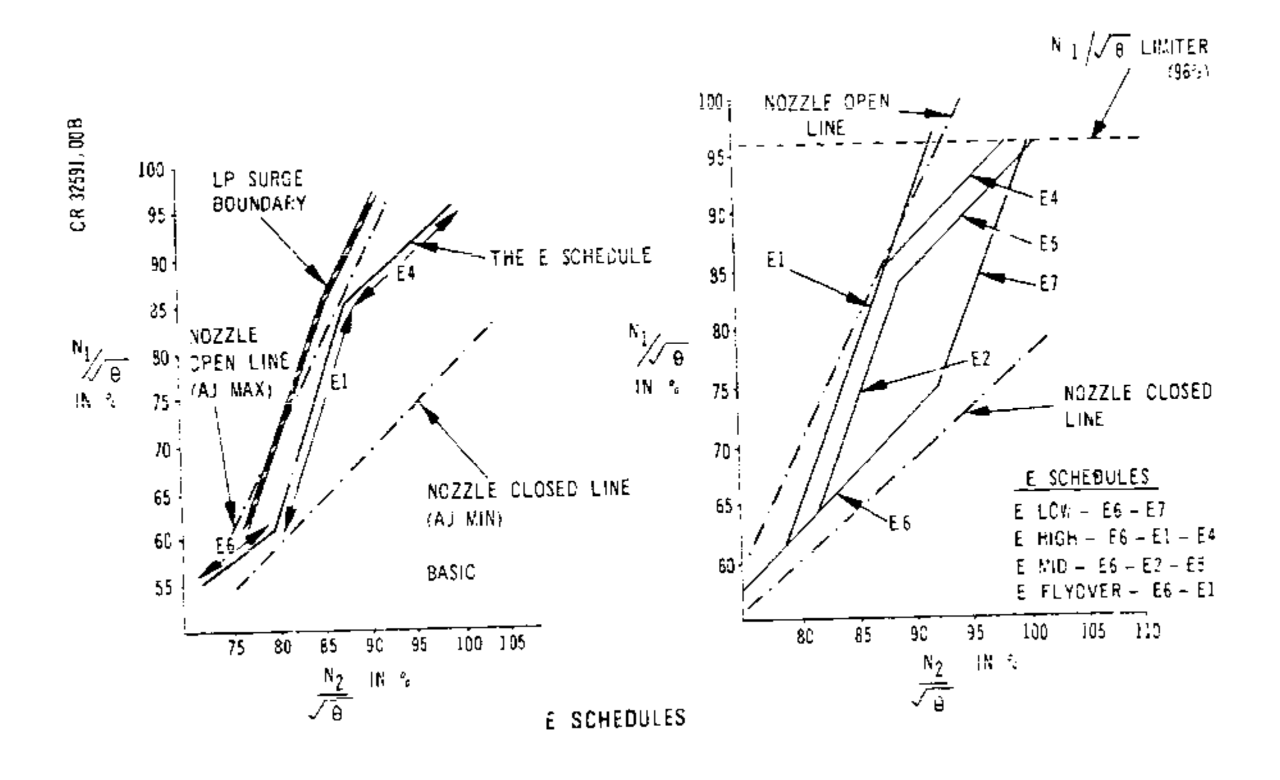
C. Other E Schedules.

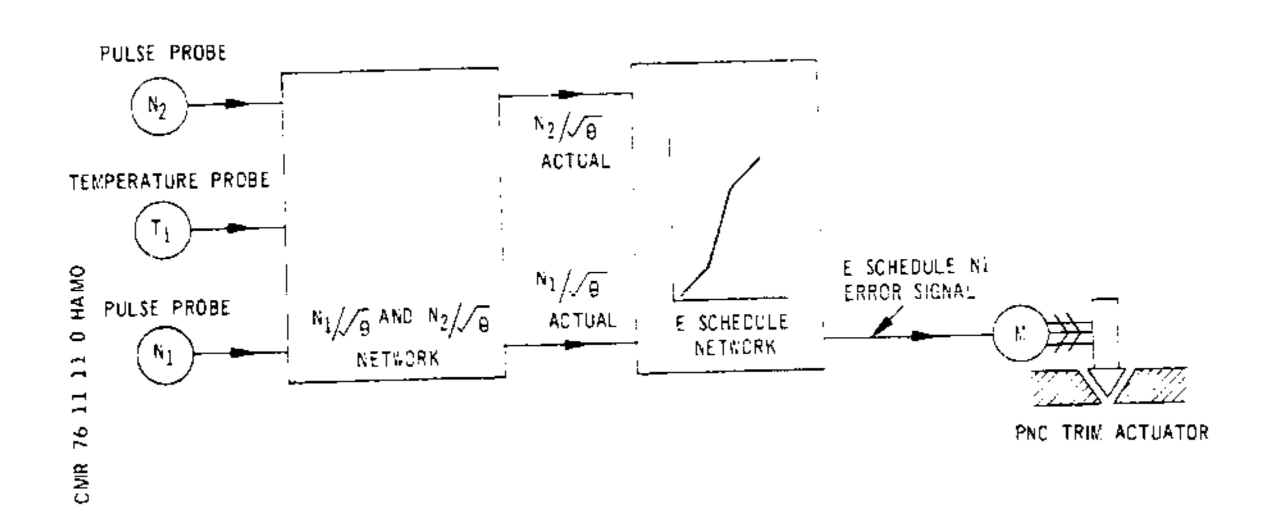
E low schedule imposes the regime of the running lines E6 and E7. Acceleration on this E low schedule determines a relatively lower N1/root theta for a given datum N2/root theta than the basic E high schedule and ensures adequate LP surge boundary margin as shown in (Ref. Fig. 010). The selection of an E mid schedule imposes the regime of the running lines E6, E2 and E5. This E mid schedule also demands a lower N1/root theta for a given datum N2/ root theta than the E high schedule. An E flyover schedule imposes the regime of the E6 and E1 running lines.

D. E Schedule Selections.

Control switch selections make the E schedule effective in control either directly or through the nozzle angle scheduling unit (NASU).

The engine control schedule switch has the position of HI, LO and AUTO. An HI selection will select the E high schedule which becomes effective in control provided the undercarriage is not locked down and operating the mating undercarriage down lock switch. Otherwise control remains on the E low schedule. The E low schedule is selected by the switch in the LO setting. An AUTO selection arms the NASU as an automatic selector for E high, E low, E mid or E flyover in response to further input signals. These additional signals are from the air data computer in respect of an air speed in excess of 220 knots and a power reduce network which has inputs from the pilot's throttle lever transmitter and the reheat selector switch. The schedule selection is made by the NASU as a function of the combined input signals.





Basic E Schedule Control Loop
and Engine Running Lines
Figure 008

CR 32590 009

E SCHEDULE SELECTOR SWITCH
HIGH
AUTO
LOW
U C DOWN LOCK SWITCH
AIR DATA COMPUTER
PROGRAMME SELECTOR
FLYOVER
NORMAL
APPROACH
NOZZLE ANGLE SCHEDULING UNIT
HIGH
FLYOVER
MID
E SCHEDULE SELECTOR
FLIGHT DECK INDICATIONS
P
POWER REDUCE
REHEAT SWITCH
TAKE-OFF
FLIGHT
RATING SELECTOR
N_2
T_1
N_1
$\frac{N}{\sqrt{\theta}}$ NETWORK
$N_2\sqrt{\theta}$
$N_1\sqrt{\theta}$
E SCHEDULE NETWORK
(E_e)
NOZZLE TRIM ACTUATOR
AUTO $N_1\sqrt{\theta}$ REDUCE

CMR 76 11 11 0 JAMA

E SCHEDULE SELECTION

E Schedule Selections and Schedule Limiters
(Sheet 1 of 2)
Figure 009

CR 32614/00C

MAX $N_2/\sqrt{\theta}$ LIMITER

$N_1/\sqrt{\theta}$ LIMITER

E4

LP SURGE BOUNDARY

E5

E7

$N_2\sqrt{\theta}$ LIMITER SCHEDULE (E3)

E1

E2

HP SURGE BOUNDARY

E6

NOZZLE OPEN LINE

NOZZLE CLOSED LINE

$\frac{N_1}{\sqrt{\theta}}$ %

100, 90, 80, 70, 60, 50

60, 70, 80, 90, 100, 110

$\frac{N_2}{\sqrt{\theta}}$ %

E SCHEDULES

E	LOW	E6 - E7 - $N_1/\sqrt{\theta}$ LIMITER
E	HIGH	E6 - E1 - E4 - $N_1/\sqrt{\theta}$ LIMITER
E	MID	E6 - E2 - E5 - $N_1/\sqrt{\theta}$ LIMITER
E	FLYOVER	E6 - E1 - $N_1/\sqrt{\theta}$ LIMITER

CMR 76 11 11 0 JAMB

E Schedule Selections and Schedule Limiters
(Sheet 2 of 2)
Figure 009

Each of the three programme selector switch positions, FLYOVER (F/O), NORMAL and APPROACH (MID) feeds a signal to the NASU which transmits the relevant E schedule selection signal to the effective control amplifier.

The NORMAL selection transfers the E schedule selection function via the NASU to the ENGINE CONTROL SCHEDULE switch while the other two selection inputs to the NASU result in signals to the effective control amplifier to make either the E mid or the E flyover schedules effective in control.

A signal from the reheat selector switch will select the E mid schedule provided that the ENG RATING MODE switch is selected to FLIGHT.

E. Limiting Networks.

In a similar manner to the fuel control circuit, limiting networks are provided in the primary nozzle control circuit to ensure that operating limitations are not exceeded. These limitations are adjusted in certain circumstances to comply with aircraft flight requirements. These limiting networks are shown in (Ref. Fig. 010).

N1 Fuel Control:

A reduction in the LP surge margin would result if the primary nozzle control network failed to control N1/root theta correctly during transient operation of the engine and the values demanded by the E schedule were exceeded. An N1/root theta rise to a value significantly greater than the E schedule datum results in a signal passing to the fuel control circuit to prevent an excursion towards surge.

The value of the N1/root theta limit can be varied by a signal from the air intake control system. This signal reduces the N1/root theta limit progressively as the aircraft Mach number increases above M 1.7, thus reducing the mass airflow and maintaining the desired engine/intake matching. This is known as the AUTO N1 REDUCE system. The auto N1 reduce signal is only available for N1/root theta reduction, when FLIGHT is selected on the ENG RATING MODE switch.

Maximum N1 governor:

The maximum rpm which the LP rotating assembly is permitted to achieve is limited. To this end a maximum N1 governor is fitted. A signal from the N1 pulse probe is

U C DOWN LOCK SWITCH
SELECTOR SWITCH
HIGH
AUTO
LOW
CR 32588 00 B
AIR DATA COMPUTER
NOZZLE ANGLE SCHEDULING UNIT
HIGH
FLYOVER
NORMAL
APPROACH
PROGRAMME SELECTOR
PILOTS LEVER
FLYOVER
MID.
E SCHEDULE SELECTOR
FLIGHT DECK INDICATIONS
POWER REDUCE
REHEAT SWITCH
TAKE-OFF
FLIGHT
RATING SELECTOR
N_1 FUEL CONTROL
ACTUATOR GEARBOX
CONTROL NETWORK
N_2
T_1
N_1
$\frac{N}{\sqrt{\theta}}$ NETWORK
$N_2/\sqrt{\theta}$
$N_1/\sqrt{\theta}$
E SCHEDULE
$N_1/\sqrt{\theta}$ LIMITER
LOWEST WINS
AUTO $N_1/\sqrt{\theta}$ REDUCE
ϵ_e
AIR INTAKE CONTROL
HW
NOZZLE OPEN
REVERSE THRUST
NOZZLE CLOSED
NOZZLE TRIM ACTUATOR N_1 (CONTROL)
MAX. N_1 GOVERNOR
P_M BOLT
CMR 76 11 11 0 KAMO

PNC Trim/N1 Control Schematic
Figure 010

taken to the governing network and compared with a fixed datum equivalent to a desired maximum rpm. The error between these two forms the output signal. This output signal is taken to the Lowest Wins Logic of the nozzle control loop. Its action can be to reduce the rate of nozzle opening when the datum rpm is approached; prevent the nozzle opening any further when the datum has been achieved and move the nozzle in a closing direction should the maximum datum rpm be exceeded.

In addition to governor, which acts on the nozzle control loop, there is a governor that acts on the fuel control loop. The datum of this governor is set just above the datum of the nozzle control loop governor. Should N1 rise above the desired datum figure, a signal is passed to the fuel control loop which acts to reduce fuel flow, and consequently N2, until N1 reaches the datum value.

PM Limiting Networks:

A signal from the PM limiting networks is passed to the Lowest Wins logic to de-energise the nozzle trim actuator motor when pre-selected angles have been achieved. During dry engine operation the angles coincide with the fully open and fully closed positions of the nozzle. The signal will then prevent the actuator being rotated any further in either sense. This prevents a lag in response of the nozzle, to a demand for a movement in the opposite sense, once the limit has been reached, which would have had occurred had an overrun of the actuator been permitted.

An N2 pulse probe signal will permit a larger actuator angle for engine starting, ensuring a fully open nozzle at low engine P3 air pressures. When reheat is selected, the PM signal controls the maximum actuator angle at a lower figure, to ensure rapid response to the nozzle closing signal or reheat shut-down, thus preventing an excessive N1 overswing.

Reverse Thrust:

Two signals emanate from the reverse thrust control circuit. When reverse is selected in flight, a signal demands a fully open nozzle. The signal is taken to a highest wins network where it overrides the E schedule demand signal and opens the nozzle fully.

When the type 28 nozzle buckets are fully closed in the reverse thrust condition, a further signal is taken to the lowest wins network to once more override the E

schedule demand and close the primary nozzle fully.

The E schedules and N/root theta limitations are shown on diagram .

F. System Safety.

Within each control amplifier is a system of safety circuits which continuously monitor the electrical integrity of the control lane. Should any failure affecting safe operation be detected within the control lane controlling the engine, a warning indication output is generated and an automatic changeover circuit is activated to make an alternative amplifier effective in control.

Nozzle angle scheduling units (NASU) are effective in the engine control system. If APPROACH is selected when an NASU fails, the engine normally controlled by the NASU will revert to the E low schedule. In the event of a double NASU failure all engines will be controlled on their E low schedules.

ENGINE CONTROL AMPLIFIER - MAIN AND ALTERNATE REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General
The main and alternate engine control amplifiers are housed in eight 1/2 ATR long cases, one of each for each engine. They are located as follows:-

ENGINE	AMPLIFIER	ZONE	SHELF
1	main	215	8
	alternate	215	6
2	main	215	6
	alternate	215	8
3	main	216	8
	alternate	216	6
4	main	216	6
	alternate	216	8

2. Engine Control Amplifier

A. Equipment and Materials.

DESCRIPTION	PART NO.
Circuit Breaker Safety Clips	-

B. Prepare to Remove Amplifier

(1) Electrically isolate the amplifier by tripping the appropriate circuit breakers. Fit circuit breaker safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R Engine No.1			
R Main Amplifier			
R Throttle control:			
R ENG 1 MAIN THROT SUP	2-213	1K1	F12
R ENG 1 MAIN THROT FAIL IND	1-213	1K5	A 1
R ENG 1 MAIN THROT CONT	3-213	1K3	A 1
R ENG 1 ALTN THROT CONT	15-216	1K4	E 8
R 'E' SCHD SUP 1	1-213	K34	E 7
R ENG 1 RATING CONT	3-213	1K8	C 3
R ENG 1 WIND DOWN CONT SUP 1	5-213	1K1101	B 1
R ENG 1 WIND DOWN IND	5-213	1K1102	B 3
R ENG 1 REHEAT CONT	15-216	1K1542	E 9
R ENG 1 LH IGNITION CONT	3-213	1J1	E 1
R ENG 1 RH INGITION CONT	1-213	1J2	N 6
R ENG 1 & 4 AIR START CONT	15-215	K181	C15
R Engine No.1			
R Alternate Amplifier			
R Throttle Control:			
R ENG 1 ALTN THROT SUP	14-215	1K2	G12
R ENG 1 ALTN THROT FAIL			
R IND & AJ SUP	3-213	1K6	B 1
R ENG 1 MAIN THROT CONT	3-213	1K3	A 1
R ENG 1 ALTN THROT CONT	15-216	1K4	E 8
R 'E' SCHED SUP 2	3-213	K35	B 3
R ENG 1 RATING CONT	3-213	1K8	C 3
R ENG 1 WIND DOWN CONT SUP 2	1-213	1K1108	C 7
R ENG 1 WIND DOWN IND	5-213	1K1102	B 3
R ENG 1 REHEAT CONT	15-216	1K1542	E 9
R ENG 1 LH IGNITION CONT	3-213	1K1	E 1
R ENG 1 RH IGNITION CONT	1-213	1J2	N 6
R ENG 1 & 4 AIR START CONT	15-215	K181	C15
R Engine No.2			
R Main Amplifier			
R Throttle Control:			
R ENG 2 MAIN THROT SUP	2-213	2K1	C12
R ENG 2 MAIN THROT FAIL IND	3-213	2K5	A 3
R ENG 2 MAIN THROT CONT	1-213	2K3	A 3
R ENG 2 ALTN THROT CONT	15-215	2K4	F15
R 'E' SCHD SUP 2	3-213	K35	B 3
R ENG 2 RATING CONT	1-213	2K8	E 8
R ENG 2 WIND DOWN CONT SUP 1	1-213	2K1101	F 4
R ENG 2 WIND DOWN IND	1-213	2K1102	F 6
R ENG 2 REHEAT CONT	15-215	2K1542	D15
R ENG 2 LH IGNITION CONT	3-213	2K1	E 2

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	ENG 2 RH IGNITION CONT	1-213	2K2	P 6
R	ENG 2 & 3 AIR START CONT	15-216	K182	D11
R	Engine No.2			
R	Alternate Amplifier			
R	Throttle Control:			
R	ENG 2 ALTN THROT SUP	13-215	2K2	F14
R	ENG 2 ALTN THROT FAIL			
R	IND & AJ MAX SUP	1-213	2K6	B 3
R	ENG 2 MAIN THROT CONT	1-213	2K3	A 3
R	ENG 2 ALTN THROT CONT	15-215	2K4	F15
R	'E' SCHED SUP 1	1-213	K34	E 7
R	ENG 2 RATING CONT	1-213	2K8	E 8
R	ENG 2 WIND DOWN CONT SUP 2	5-213	2K1108	C 1
R	ENG 2 WIND DOWN IND	1-213	2K1102	F 6
R	ENG 2 REHEAT CONT	15-215	2K1542	D15
R	ENG 2 LH IGNITION CONT	3-213	2K1	E 2
R	ENG 2 RH IGNITION CONT	1-213	2K2	P 6
R	ENG 2 & 3 AIR START CONT	15-216	K182	D11
R	Engine No.3			
R	Main Amplifier			
R	Throttle Control:			
R	ENG 3 MAIN THROT SUP	2-213	3K1	C13
R	ENG 3 MAIN THROT FAIL IND	3-213	3K5	A 4
R	ENG 3 MAIN THROT CONT	1-213	3K3	A 4
R	ENG 3 ALT THROT CONT	15-215	3K4	F16
R	'E' SCHED SUP 2	3-213	K35	B 3
R	ENG 3 RATING CONT	1-213	3K8	E 2
R	ENG 3 WIND DOWN CONT SUP 1	1-213	3K1101	F 5
R	ENG 3 WIND DOWN IND	1-213	3K1102	F 7
R	ENG 3 REHEAT CONT	15-215	3K1542	D16
R	ENG 3 LH IGNITION CONT	3-213	3J1	E 3
R	ENG 3 RH IGNITION CONT	1-213	3K2	Q 6
R	ENG 2 & 3 AIR START CONT	15-216	K182	D11
R	Engine No.3			
R	Alternate Amplifier			
R	Throttle Control:			
R	ENG 3 ALTN THROT SUP	13-216	3K2	A 7
R	ENG 3 ALTN THROT FAIL IND			
R	& AJ MAX SUP	1-213	3K6	B 4
R	ENG 3 MAIN THROT CONT	1-213	3K3	A 4
R	ENG 3 ALTN THROT CONT	15-215	3K4	F16
R	'E' SCHED SUP 1	1-213	K34	E 7
R	ENG 3 RATING CONT	1-213	3K8	E 2

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	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	ENG 3 WIND DOWN CONT SUP 2	5-213	3K1108	C 2
R	ENG 3 WIND DOWN IND	1-213	3K1102	F 7
R	ENG 3 REHEAT CONT	15-215	3K1542	D16
R	ENG 3 LH IGNITION CONT	3-213	3K1	E 3
R	ENG 3 RH IGNITION CONT	1-213	3J2	Q 6
R	ENG 2 & 3 AIR START CONT	15-216	K182	D11
R	Engine No.4			
R	Main Amplifier			
R	Throttle Control:			
R	ENG 4 MAIN THROT SUP	2-213	4K1	F13
R	ENG 4 MAIN THROT FAIL IND	1-213	4K5	A 2
R	ENG 4 MAIN THROT CONT	3-213	4K3	A 2
R	ENG 4 ALT THROT CONT	15-216	4K4	F11
R	'E' SCHD SUP 1	1-213	K34	E 7
R	ENG 4 RATING CONT	3-213	4K8	C 4
R	ENG 4 WIND DOWN CONT SUP 1	5-213	4K1101	B 2
R	ENG 4 WIND DOWN IND	5-213	4K1102	B 4
R	ENG 4 REHEAT CONT	15-216	4K1542	E10
R	ENG 4 LH IGNITION CONT	3-213	4J1	E 4
R	ENG 4 RH IGNITION CONT	1-213	4J2	R 6
R	ENG 1 & 4 AIR START CONT	15-215	K181	C15
R	Engine No.4			
R	Alternate Amplifier			
R	Throttle Control:			
R	ENG 4 ALTN THROT SUP	14-216	4K2	C 7
R	ENG 4 ALTN THROT FAIL IND			
R	& AJ MAX SUP	3-213	4K6	B 2
R	ENG 4 MAIN THROT CONT	3-213	4K3	A 2
R	ENG 4 ALT THROT CONT	15-216	4K4	F11
R	'E' SCHED SUP 2	3-213	K35	B 3
R	ENG 4 RATING CONT	3-213	4K8	C 4
R	ENG 4 WIND DOWN CONT SUP 2	1-213	4K1108	C 8
R	ENG 4 WIND DOWN IND	5-213	4K1102	B 4
R	ENG 4 REHEAT CONT	15-216	4K1542	E10
R	ENG 4 LH IGNITION CONT	3-213	4J1	E 4
R	ENG 4 RH IGNITION CONT	1-213	4J2	R 6
R	ENG 1 & 4 AIR START CONT	15-215	K181	C15

(2) Remove the cover from the appropriate racking and identify the amplifier to be removed.

C. Remove Amplifier

(1) Release the lever latch handles.

(2) Grasp the handles and carefully withdraw the amplifier from the backplate connector; remove the amplifier from the shelf.

D. Install Amplifier

RB CAUTION: WHEN INSTALLING AN AMPLIFIER ENSURE THAT
RB THE YELLOW FLAP ON THE FACE OF THE UNIT IS
RB SECURELY WIRE LOCKED, WITH THE TOGGLE OF
RB THE EGT SWITCH IN THE UPPER HOLE IN THE
RB FLAP (POSITION 2).

RB (1) When installing an amplifier, ensure that there is
RB at least one unit on the aircraft which features a
RB Fault Isolation Module (FIM). Where there are no
RB such FIM units fitted and a spare is not available,
RB raise an ADD to the effect that a FIM equipped
RB amplifier should be fitted at the earliest
RB opportunity.

(2) Comply with the electrical safety precautions.

(3) Ensure that the mating surfaces of the backplate connector are clean and undamaged.

(4) Position the amplifier on the shelf runners then slide it outboard until the backplate connector just engages.

(5) Simultaneously engage the latch lock handles, ensuring that the amplifier is bonded in accordance with 20-27-11.

(6) Remove the safety clips and reset the circuit breakers tripped before removal.

(7) Perform an Operational Test of the system (Ref. 76-11-11, Adjustment/Test).

B NOTE: When removing/installing the "Engine Control
B Amplifiers(Main and/or Alternate)" make an
B entry in the Aircraft Technical Report (Sector
B Defect Log) that a secondary nozzle ASOV
B check must be carried out on departure from
B that station/base.

R B Manual requirement.

ENGINE CONTROL AMPLIFIER (MAIN AND ALTERNATE) - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

This topic describes an Operational test that is to be carried out when an amplifier either main or alternate, has been changed in an otherwise serviceable system. If more extensive checks are necessary, carry out the following:

(1)	Test set confidence checks	) Ref.
		) 76-11-00
(2)	Engine control system test procedure	) Adjust-
		) ment/
(3)	Installed amplifier datum setting checks adjustment.	) Test

2. Operational Test

A. Prepare

(1) Ensure that the amplifier has been replaced in accordance with 76-11-11, Removal/Installation.

NOTE: After SB 76-016 check that the 'EGT' switch on the front of the amplifier is set and retained
R B at POSITION 2.

(2) On the pilots' roof panel 4-211 confirm that:

(a) The HP VALVE switch is set to "SHUT".

(b) The THROTTLE MASTER switch is set to "OFF".

(c) The throttle lever is set to idle.

(3) Make available electrical ground power (Ref. 24-41-00).

B. Test

On the pilots' roof panel:

(1) Set the HP VALVE switch to "OPEN", if it is undesirable to open the valve, trip the appropriate circuit breaker:

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1 HP VALVE CONT	3-213	1K131	C1
ENG 2 HP VALVE CONT	1-213	2K131	C3
ENG 3 HP VALVE CONT	1-213	3K131	C4
ENG 4 HP VALVE CONT	3-213	4K131	C2

Check that the THROT fail caption (Red) and the Master Warning System (MWS) ENG caption (Red) illuminate and that the gong sounds.

(2) Set the THROTTLE MASTER switch to "MAIN" or "ALTERN", as appropriate, and check that the warnings cancel.

NOTE: A short period (seconds) will normally elapse before a fault becomes evident.

R (3) Perform a Bucket Control System Wind Down Test
R (Ref.78-00-00, Adjustment/Test).

R After SB 76-015 For A/C 001-007,

R (4) With the amplifier switched on, reset the FIM
R facility:

R (a) Press the reset push button and check that
R all the FIM indicators illuminate as a self-
R test facility.

R (b) Release the reset button to clear the memory,
R shown by the extinguishing of all four
R indicators. This is the code for no fault.

C. Conclusion

(1) Set the THROTTLE MASTER switch to "OFF".

(2) Set the HP VALVE switch to "SHUT", or set the circuit breakers; if these were tripped as part of the test.

(3) Remove electrical ground power (Ref 24-41-00).

THROTTLE CONTROL TRANSMITTER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00

1. General

Each throttle transmitter can be removed and replaced independently, and the units are interchangeable between throttle channels. For access to the transmitters, remove the centre console side panels and hinge back the crate.

2. Transmitter

A. Equipment and Materials

DESCRIPTION	PART NO.
Screwdriver, torque limiting 0-80 lbf in (0-0.89 mdaN)	-
Locking pins (2), droop nose	E925045031
Locking wire, stainless steel 0.028 in (0.71 mm) dia	

B. Preparation (Ref. Fig.401 and 402)

(1) Trip the appropriate circuit breakers and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
NOSE 7 1/2° CONT	1-213	M12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17
CHART STOWAGE LTS SUP	15-216	L237	D12
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ALT THROT CONT	15-216	1K4	E 8
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALT THROT CONT	15-215	2K4	F15
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALT THROT CONT	15-215	3K4	F16
ENG 4			
MAIN THROT CONT	3-213	4K3	A 2
ALT THROT CONT	15-216	4K4	F11

(2) Remove the centre console aft lefthand side panel:

(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilot's floor illumination at the receptacle identified U2026 on the panel.

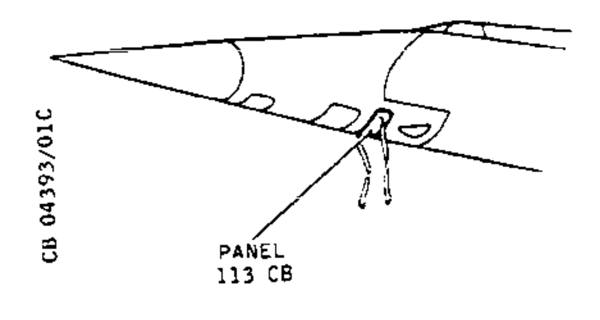
(c) Lift the panel clear of the spigots and remove the panel.

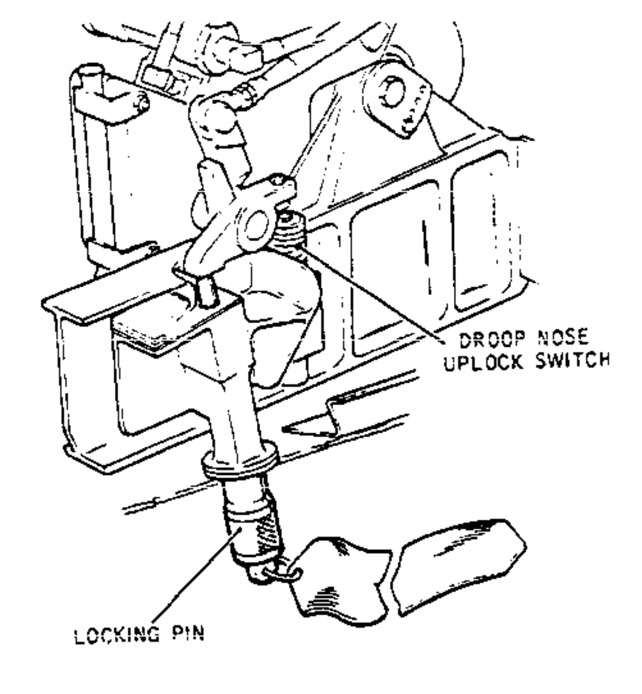
(3) Remove the droop nose emergency lever (Ref. Fig.401 and 403).
NOTE: This can be done with the nose either up or down.

(a) If the nose is up, fit safety pins (2) in the droop nose mechanism.

(b) Remove the quick-release pin at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the lefthand side and depress the spring loaded pin on the forward end of the droop nose emergency lever; remove the lever.





CMB 76 11 12 4 AAM0

Droop Nose Locking Pins
R Figure 401

(4) Remove the centre console aft righthand side panel in a similar manner to that described for the lefthand; the electrical plug identification is U2025.

(5) Remove the screws securing the check list stowage, remove the stowage.

(6) Remove the securing screws and hinge back the crate.

C. Remove Transmitter (Ref. Fig.402 and 403)

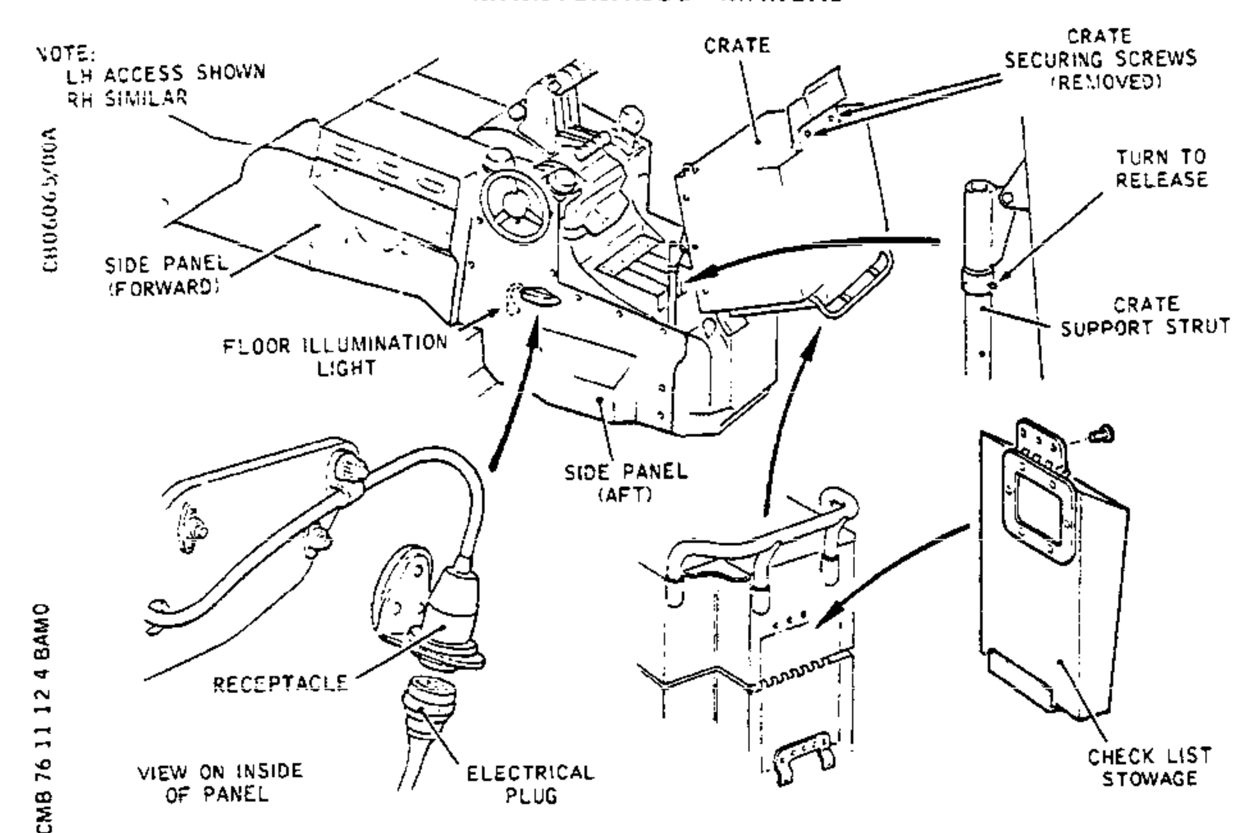
(1) Set the throttle lever to 'idle'.

(2) Unscrew the knurled nut and withdraw the transmitter.

D. Prepare to Install Transmitter (Ref. Fig. 402)

(1) Comply with the electrical safety precautions.

(2) Comply with the droop nose safety precautions.



Centre Console - Access
Figure 402

R

(3) Ensure that the transmitter racking is clean and free from swarf and other debris, and that the electrical connections on the transmitter and the racking are clean and undamaged.

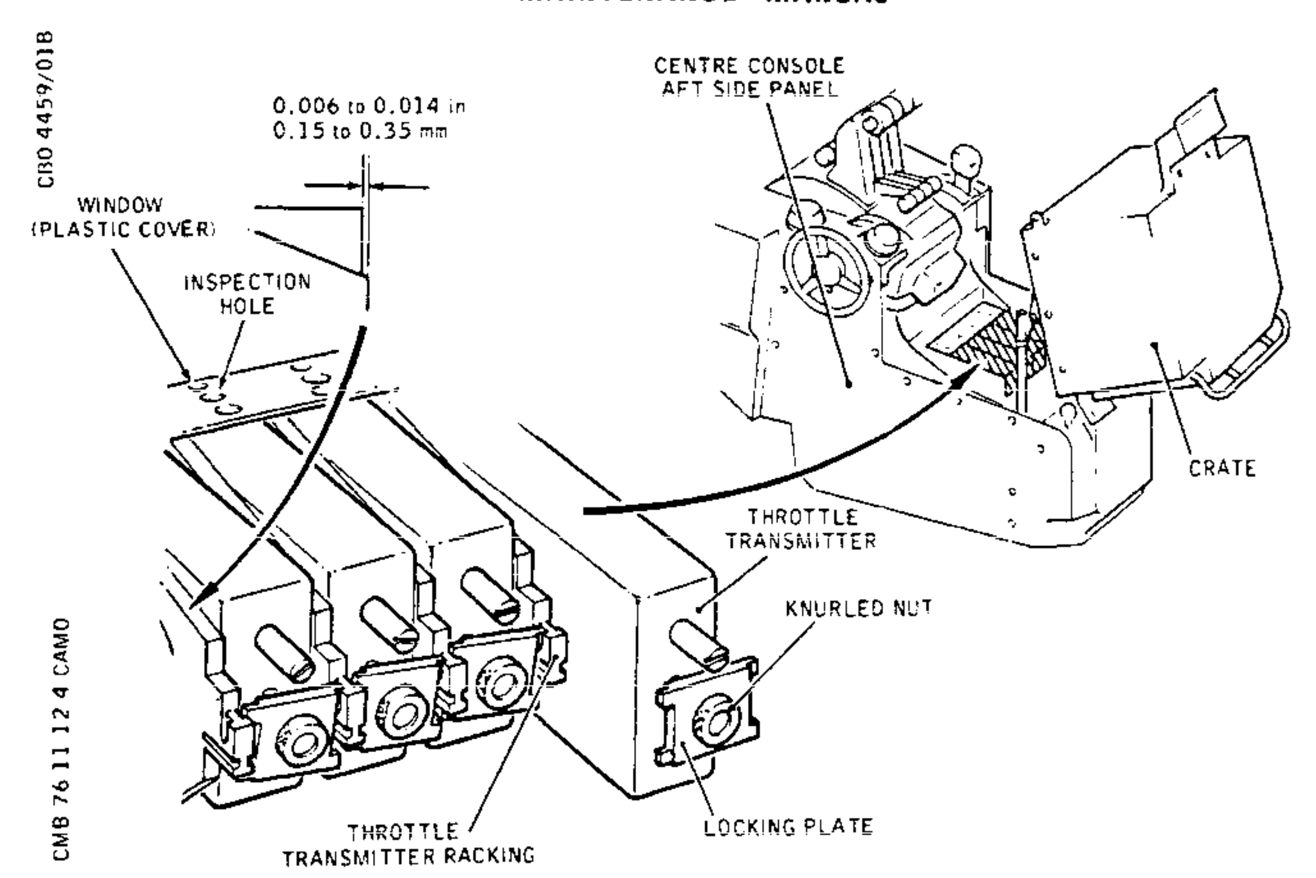
E. Install Transmitter

(1) Set the throttle lever to 'idle'.

(2) Install the transmitter, locate it on the dowels and tighten in on the knurled nut. Check through the inspection hole that the transmitter is flush with the face of the transmitter racking.

NOTE: It is essential that the transmitter fully engages and abuts the racking face.

(3) Check that the dimension from the shoulder on the engine transmitter racking to the end of the transmitter is between 0.006 and 0.014 in (0.157 and 0.355 mm).



R Throttle Transmitter - Removal/Installation
Figure 403

(4) Check by looking through the small windows that all four bellows are in line; to ensure all bellows have engaged correctly.

F. Conclusion (Ref. Fig.401 and 402)

(1) Release the lock and hinge forward the crate.

(2) Assemble the two securing screws and, using the torq-set screwdriver, torque load them to between 70-80 lbf in (0.78 and 0.89 mdaN).

(3) Engage the check list stowage with the rear of the crate, fit and tighten the securing screws.

(4) Secure the centre console aft righthand side panel:

(a) Check the panel seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilot's floor illumination at the receptacle identified U2025 on the panel, ensure that the connections are made in accordance with the cable identification and the applicable wiring diagram.

(d) Using the torq-set screwdriver torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(5) Fit the droop nose emergency release lever on the righthand side of the centre console and insert the quick-release pin.

(6) Secure the centre console aft lefthand side panel in a manner similar to that described for the righthand panel, the electrical plug is idented U2026.

(7) Remove the locking pins (2) from the droop nose.

(8) Remove the clips and set the circuit breakers previously tripped.

(9) Carry out the test on the throttle transmitter (Ref.76-11-12, Adjustment/Test).

THROTTLE TRANSMITTER - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

This topic details the test required after changing a throttle transmitter. The test is detailed for No.1 throttle transmitter and may be repeated on the other throttle transmitters.

2. Test Using Main Throttle Amplifier

A. Equipment and Materials

DESCRIPTION	PART NO.
Test set	QT6A15/24
Circuit breaker safety clips	-

B. Prepare (Ref. Fig. 501)

(1) Trip the appropriate circuit breakers and fit safety clips.

(Ref. Fig. 502)

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No.1 Main Amplifier			
ENG 1 MAIN THROT. SUP.	2-213	1K1	F12
ENG 1 MAIN THROT. FAIL IND.	1-213	1K5	A1
ENG 1 MAIN THROT. CONT.	3-213	1K3	A1
ENG 1 HP VALVE CONT.	3-213	1K131	C1
Engine No.1 alternative amplifier			
ENG 1 ALT THROT SUP.	14-215	1K2	G12
ENG 1 ALT. THROT. FAIL IND. & MAX. AJ MAX. SUP.	3-213	1K6	B1
ENG 1 ALT. THROT. CONT.	15-216	1K4	E8
ENG 1 HP VALVE CONT.	1-213	1K131	C1

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No.2 Main Amplifier			
ENG 2 MAIN THROT. SUP.	2-213	2K1	C12
ENG 2 MAIN THROT. FAIL IND.	3-213	2K5	A3
ENG 2 MAIN THROT. COND.	1-213	2K3	A3
ENG 2 HP VALVE CONT.	1-213	2K131	C3
Engine No.2 Alternative Amplifier			
ENG 2 ALT. THROT. SUP.	13-215	2K2	F14
ENG 2 ALT. THROT. FAIL IND. & AJ MAX. SUP.	1-213	2K6	B3
ENG 2 ALT. THROT. CONT.	15-215	2K4	F15
ENG 2 HP VALVE CONT.	1-213	2K131	C3
Engine No.3 Main Amplifier			
ENG 3 MAIN THROT. SUP.	2-213	3K1	C13
ENG 3 MAIN THROT. FAIL IND.	3-213	3K5	A4
ENG 3 MAIN THROT. CONT.	1-213	3K3	A4
ENG 3 HP VALVE CONT.	1-213	3K131	C4
Engine No.3 Alternative Amplifier			
ENG 3 ALT. THROT. SUP.	13-216	3K2	C5
ENG. 3 ALT. THROT. FAIL IND. & AJ MAX. SUP.	1-213	3K6	B4
ENG. 3 ALT. THROT. CONT.	15-215	3K4	F16
ENG 3 HP VALVE CONT.	1-213	3K131	C4
Engine No.4 Main Amplifier			
ENG 4 MAIN THROT. SUP.	2-213	4K1	F13
ENG 4 MAIN THROT. FAIL IND.	1-213	4K5	A2
ENG 4 MAIN THROT. CONT.	3-213	4K3	A2
ENG 4 HP VALVE CONT.	3-213	4K131	C2
Engine No.4 Alternative Amplifier			
ENG 4 ALT. THROT. SUP.	14-216	4K2	C7
ENG 4 ALT. THROT. FAIL IND. & AJ MAX. SUP.	3-213	4K6	B2
ENG 4 ALT. THROT. CONT.	15-216	4K4	F9
ENG 4 HP VALVE CONT.	3-213	4K131	C2

(2) Make available electrical ground power (Ref. 24-41-00).

(3) Check that the following aircraft switches and levers are set as follows on No.1 engine under test.

3CM station:
E schedule control switch — LO

Ignition control switch — OFF
Ignition selector — OFF

Centre console:
Throttle lever — Idle

Reheat control switch — OFF

Pilots' roof panel:

Auto ignition control — OFF

HP valve control switch — OFF

Throttle master switch — OFF

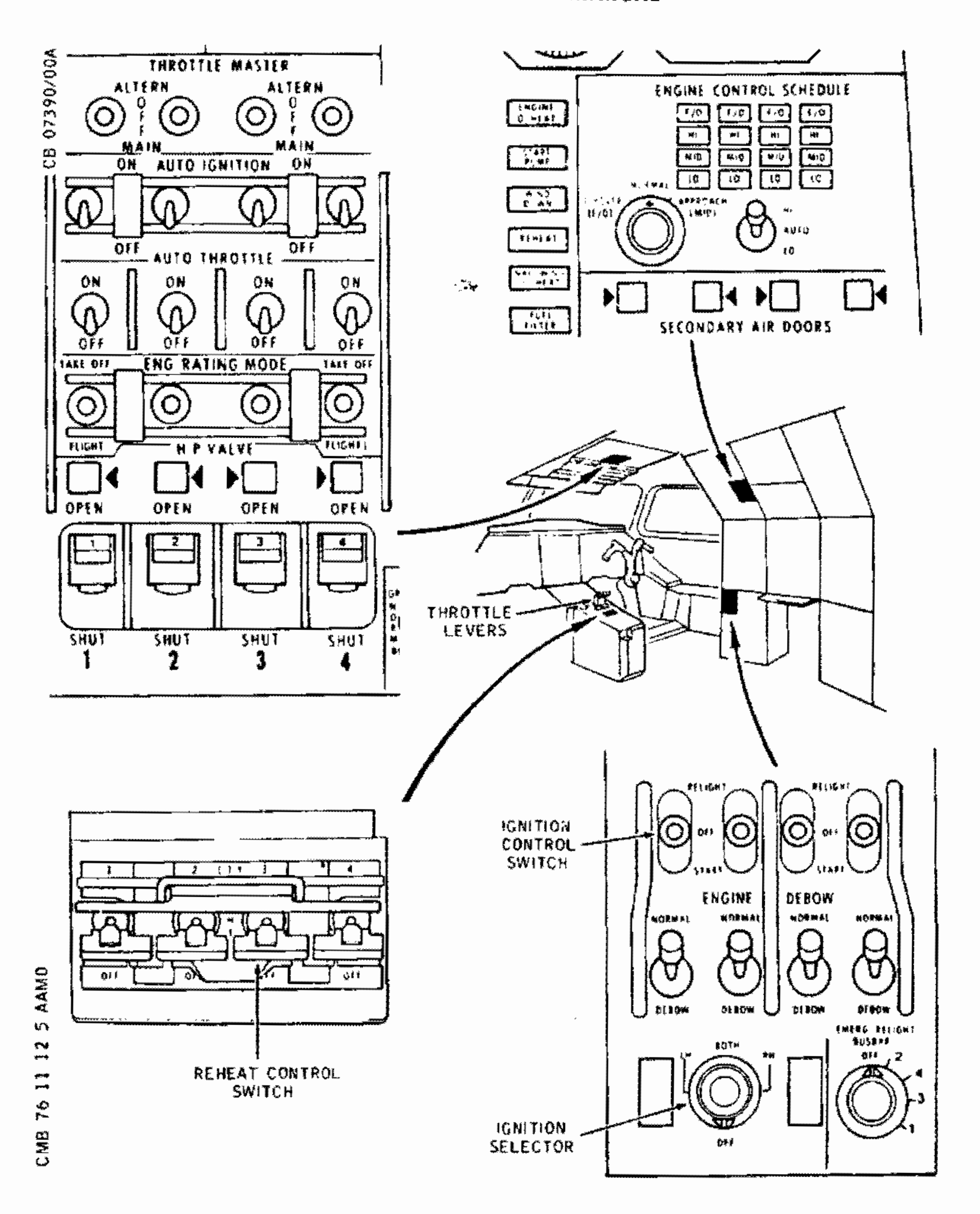
Engine rating mode switch — TAKE-OFF

(4) Remove the cover from the appropriate racking and identify the main amplifier in No.1 engine throttle control system.

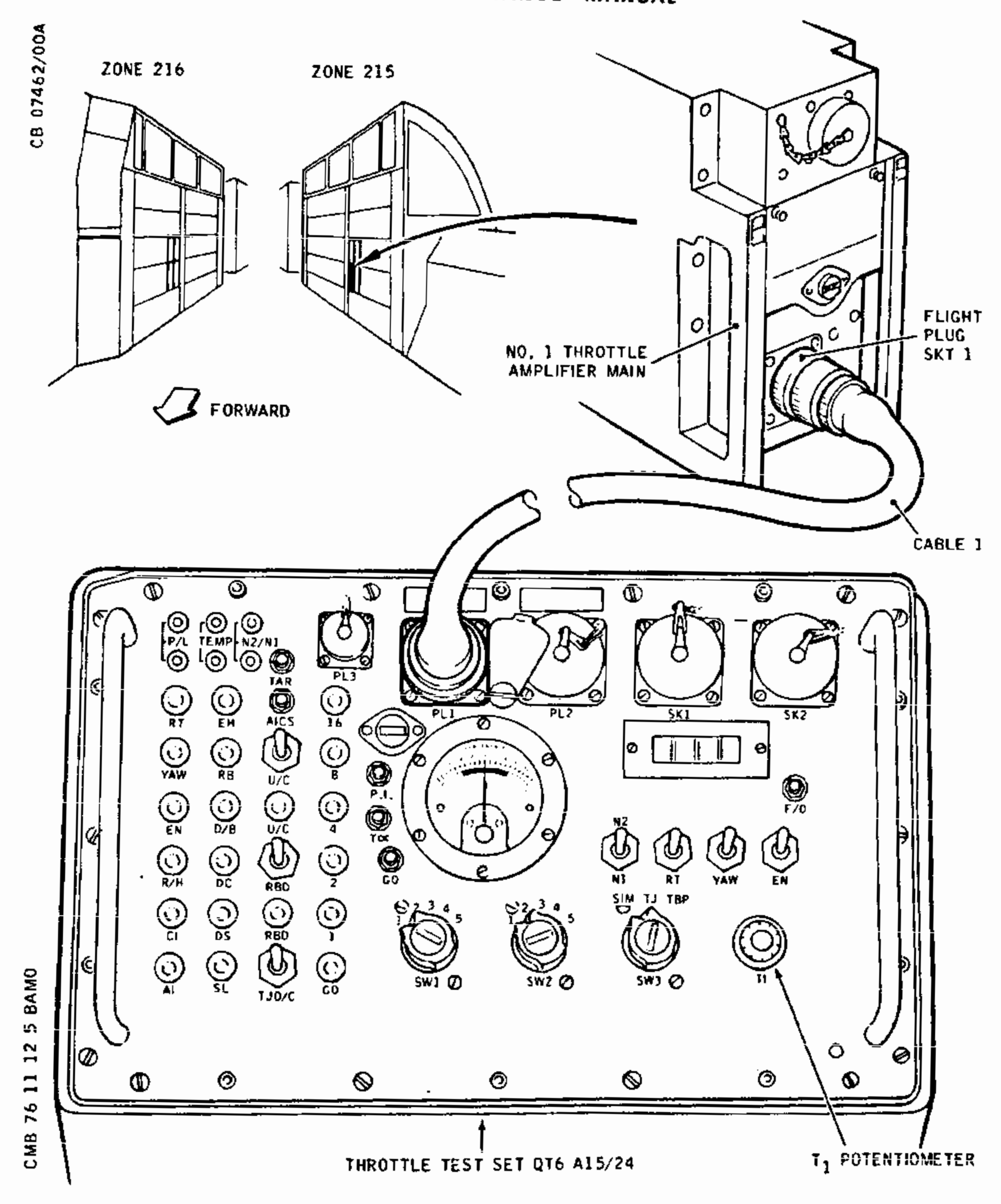
ENGINE	AMPLIFIER	ZONE	SHELF
1	main	215	8
	alternate	215	6
2	main	215	6
	alternate	215	8
3	main	216	8
	alternate	216	6
4	main	216	6
	alternate	216	8

(5) Connect the test set:

(a) Remove the flight plug SKT1 from the front of the throttle amplifier.



Throttle Transmitter - Test
Figure 501



R

Throttle Test Set
Figure 502

(b) Connect test set cable 1 between socket SKT1 on the amplifier and socket PL1 on the test set.

(6) Remove the safety clip and set the MAIN THROT SUP, 1K1 circuit breaker.

C. Test

(1) Set the throttle control test set:

(a)	Switch SW1 to	1
(b)	Switch SW2 to	1
(c)	Switch SW3 to	SIM
(d)	Switch EN to	Up
(e)	Switch YAW to	Up
(f)	Switch RT to	Up
(g)	Switch Tj o/c to	Up
(h)	Set T1 potentiometer to	378 divisions

(2) Check the test set:

(a) Check that the test set 'GO' light is illuminated and that the position indicator shows 30.

NOTE: Advance to 30, if necessary, by pressing the GO button.

(b) Check that the YAW, EN and REHEAT lights are out.

(3) Set test set switch SW2 to position 2. Check the meter reading on the test set, this is to be zero plus or minus 10 percent.

(4) Set test set switch SW2 to position 3; check that the meter indicates a positive voltage.

(5) Move the pilots' throttle lever fully forward; check that the test set meter indicates zero plus or minus 10 percent.

(6) Set test set switch SW2 to position 2; check that the meter indicates a positive voltage.

NOTE: If these readings are not obtained, check the mechanical input of the throttle lever system (Ref.76-11-00, Adjustment/Test); if this is correct refer to trouble shooting.

D. Conclusion

(1) When the test has been completed satisfactorily trip circuit breakers MAIN THROT SUP.

(2) Disconnect the test set from the amplifier by removing test set cable 1 from socket SKT1 on the amplifier.

(3) Check that the flight plug is clean and undamaged and reconnect it to amplifier socket SKT1.

(4) Remove the test set.

(5) Remove the safety clips and reset the circuit breakers previously tripped in the table.

(6) Return the pilots' throttle lever to 'idle'.

(7) Make available electrical ground power. (Ref. 24-41-00).

(8) On the pilots' roof panel switch on the THROTTLE MASTER switch to MAIN.

NOTE: 1. The amplifier is automatically checked out when it is switched 'on', or fault will be indicated by the illumination of the THROT FAIL caption of the master warning system. The full warning will be THROT, MWS and THROTTLE MASTER captions illuminated (red) and an audible gong.

2. Operation No.9 may be omitted if the transmitter does not indicate a fault in the throttle system.

(9) If a fault is indicated, switch off the amplifier and trip the ac and dc circuit breakers, MAIN THROT SUP AND MAIN THROT CONT., as previously described. Check flight plug SKT1 on the amplifier. Repeat operations Nos. 5, 6, 7 and 8.

(10) When the check is completed satisfactorily, switch off electrical ground power (Ref.24-41-00).

(11) Switch off the THROTTLE MASTER switch.

3. Test Using Alternate Throttle Amplifier

The alternate throttle amplifier is tested in exactly the

same manner as that described for the main amplifier, but using the appropriate circuit breakers and panel location.

END OF THIS SECTION

NEXT

TOTAL TEMPERATURE (T1) PROBE - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00 AND THE HYDRAULIC SAFETY PRECAUTIONS DETAILED IN 29-00-00.

OBSERVE THE SAFETY PRECAUTIONS ASSOCIATED WITH ENGINE AIR INTAKE ENTRY DETAILED IN 71-00-00 SERVICING.

1. General (Ref. Fig. 401)

A probe is located in each air intake diffuser to the rear of the rear ramp hinge, access is gained from the air intake.

This procedure details the instructions for No.1 intake, the probes in other intakes may be removed and installed in a similar manner.

2. Total Temperature (T1) Probe

A. Equipment and Materials

	DESCRIPTION	PART NO.
R R	Torque spanner 70 to 80 lbf in (0.79 to 0.90 mdaN)	-
	Circuit breaker safety clips	-

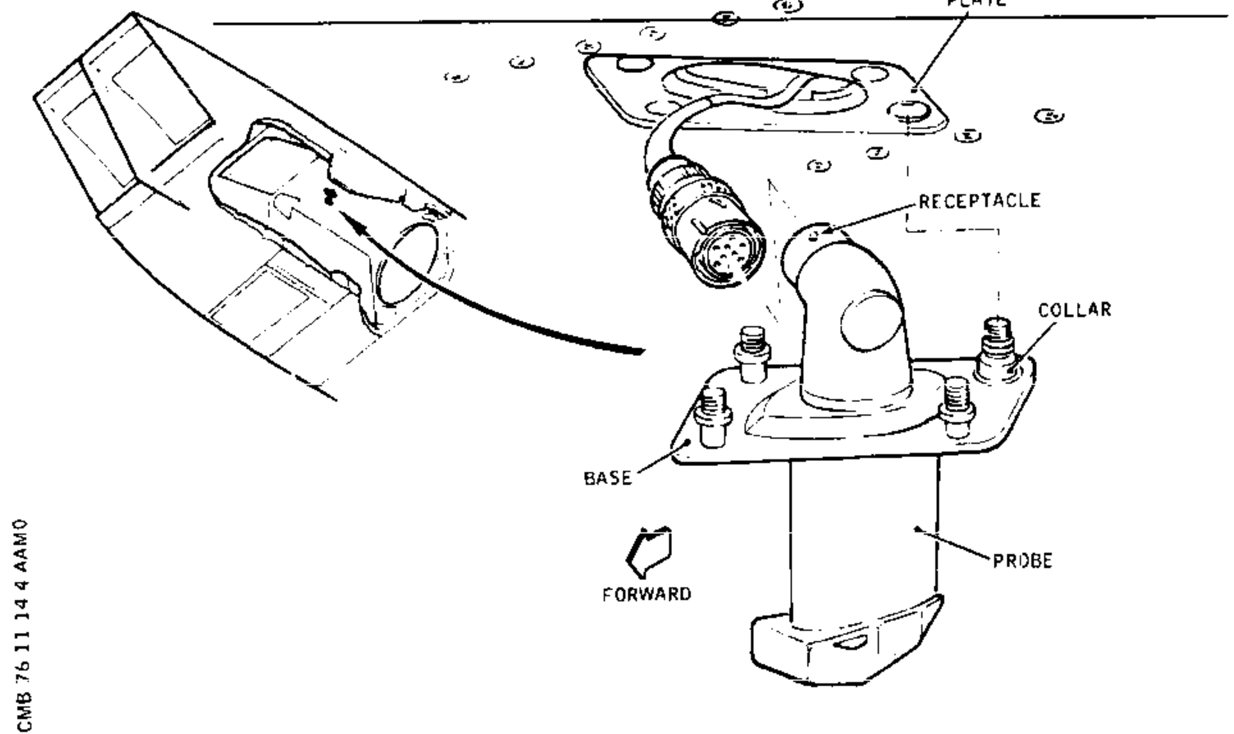
B. Prepare to remove probe

(1) Gain entry to the intake (Ref. 71-00-00, Servicing).

(2) Trip the additional circuit breakers and fit safety clips.

R	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
	ENGINE NO 1			
R	ENG 1 HP VALVE CONT	3-213	1K131	C1
R	NO 1 TI PROBE HTR SUP	13-215	1H542	C9
R	ENGINE NO 2			

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 2 HP VALVE CONT	1-213	2K131	C3
NO 2 TI PROBE HTR SUP	14-215	2H542	E8
ENGINE NO 3			
ENG 3 HP VALVE CONT	1-213	3K131	C4
NO 3 TI PROBE HTR SUP	14-216	3H542	C14
ENGINE NO 4			
ENG 4 HP VALVE CONT	3-213	4K131	C2
NO 4 TI PROBE HEATER SUP	13-216	4H452	C11



Total Temperature (T1) Probe - Installation
Figure 401

C. Remove Probe (Ref. Fig. 401)

WARNING: IT IS DANGEROUS TO ENTER AN AIRCRAFT INTAKE

WITH HYDRAULIC POWER ON THE AIRCRAFT.

(1) Enter the intake.

CAUTION: TO PREVENT DISTORTION OF THE PROBE BASE, REMOVE THE RETAINING BOLTS EVENLY IN SEQUENCE.

(2) Remove the four captive bolts securing the probe to the intake diffuser; support the probe.

(3) Disconnect the electrical plug from the receptacle and remove the probe.

D. Prepare to Install Probe

(1) Comply with the safety precautions detailed in 24-00-00 and 71-00-00, Servicing.

E. Install Probe (Ref. Fig. 401)

(1) Support the probe, connect the electrical plug to the probe receptacle, ensuring that the connection is made in accordance with the cable identification and the applicable wiring diagram.

CAUTION: TO PREVENT DISTORTION OF THE PROBE BASE TIGHTEN THE RETAINING BOLTS EQUALLY.

(2) Secure the probe to the intake diffuser.

(a) Engage the rear retaining bolt collar with the diffuser plate and assemble the rear captive bolt one turn.

(b) Engage each of the three remaining captive bolts one turn with the diffuser plate.

(c) Continue to tighten each bolt in increments of not more than one turn.

(d) Torque load each bolt to between 70 and 80 lbf
R in (0.79 and 0.90 mdaN).

F. Conclusion

(1) Vacate the intake (Ref. 71-00-00, Servicing).

(2) Remove the safety clips and reset the circuit breakers previosly tripped.

(3) Test the probe in accordance with 76-11-14, Adjustment/Test.

R B 3. Engine Control Amplifier Lane Changes Due to Intake T1 Probe

R B Where an engine control amplifier lane change has occurred (red MWS and throttle caption illuminated) and a fault interrogation of the engine control system reveals a T1 probe open or short circuit, carry out the following.

R B A. Procedure

(1) Disconnect probe from intake and measure the resistance across pins F & D, G & E, C & K, J & H. The measured resistance is a function of temperature - see Figure 402 for values.

(2) Carry out an insulation resistance check of each pin which should be greater than 1 megohm.

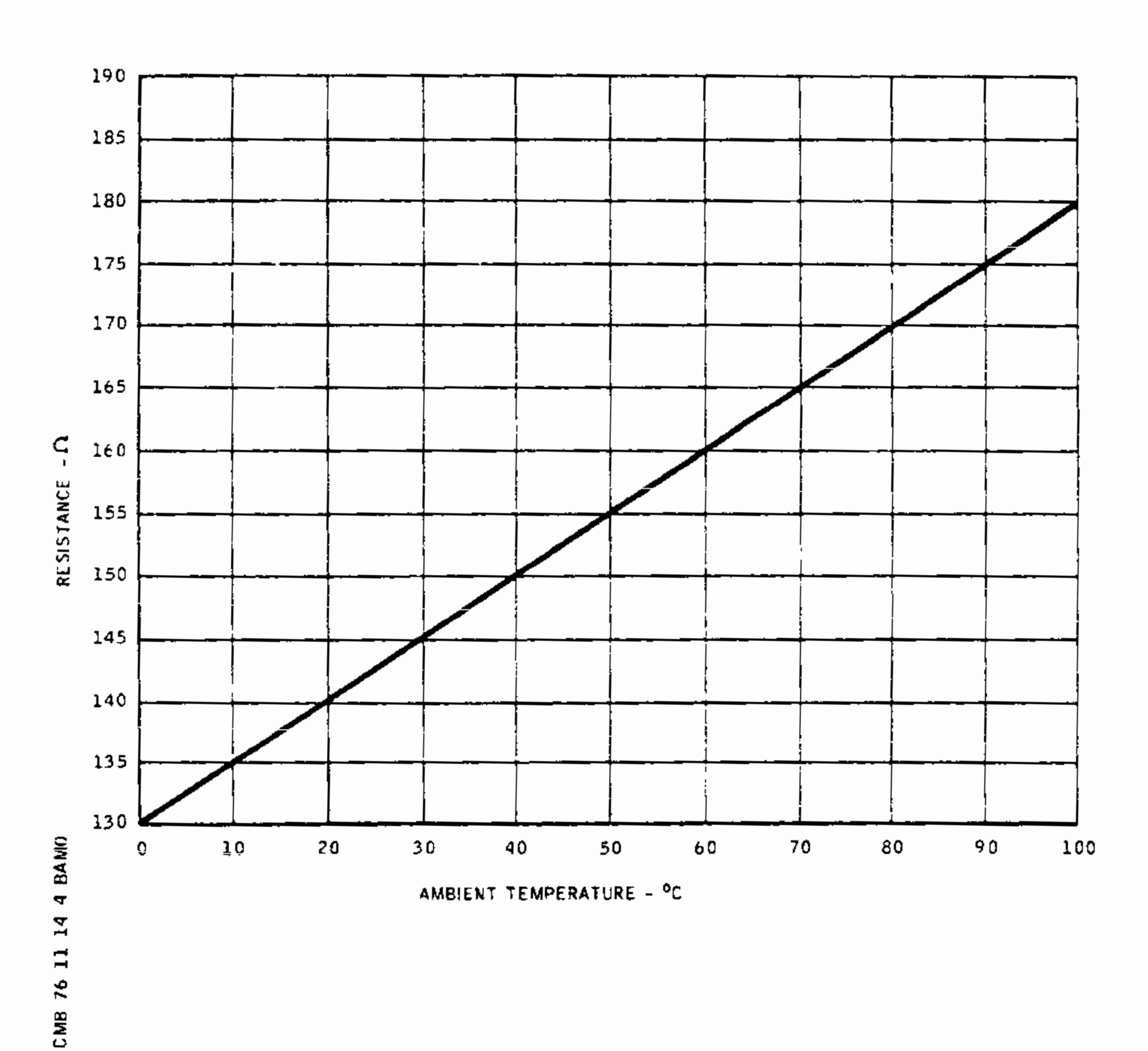
(3) Examine the pins of the probe with a X 10 magnifying glass and if the pins are found to be contaminated (i.e. with black marks, or a clear sticky substance on the pins and diaphragm), clean the probe connector with Xylene Code MAGC 3644. Using a clean cloth soaked in Xylene, attempt to rub the black deposits from the pins. Use a matchstick or suitable alternative with the cloth wrapped around the matchstick.

(4) If the sockets in the free connector are a loose fit on the pin (use a dummy male pin), replace the free connector completely.

(5) Re-install the probe in the intake and carry out function check i/a/w 76-11-14 Page 502 Paras C & D.

(6) If the throttle fail caption still illuminates, check the aircraft wiring from intake to engine control amplifier Dpx.

CB 09480/00A



Variation of Resistance with Temperature for Engine Intake T1 Probe
Figure 402

B
B

TOTAL TEMPERATURE (T1) PROBE - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00. THE T1 PROBE WILL BE SWITCHED ON DURING THIS TEST. ENSURE THAT THE AREA SURROUNDING THE APPROPRIATE PROBE IS CLEAR OF PERSONNEL AND EQUIPMENT.

1. General

This topic describes an Operational test that is to be carried out when the No. 1 air intake temperature probe has been changed in an otherwise serviceable system. The probes in other intakes may be tested in a similar manner. If more extensive checks are necessary carry out the following:

(1) Test Set confidence checks) Ref.76-11-00) Adjustment/
(2) Engine control system test procedure) Test

The intake probes serve the following amplifiers:

TOTAL TEMPERATURE PROBE	ENGINE CONTROL AMPLIFIER
Intake No. 1	No. 1 MAIN
	No. 2 ALTERN
Intake No. 2	No. 2 MAIN
	No. 1 ALTERN
Intake No. 3	No. 3 MAIN
	No. 4 ALTERN
Intake No. 4	No. 4 MAIN
	No. 3 ALTERN

2. T1 Probe

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare

(1) Ensure that the Removal/Installation has been completed in accordance with 76-11-14, Removal/ Installation.

(2) Make available electrical ground power (Ref. 24-41-00).

(3) On the pilots' roof panel 4-211 confirm that the No. 1 HP VALVE is set to "SHUT" and the No. 1 T1 failure warning caption on the warning lights module is illuminated.

C. Test T1 Probe Anti-icing

(1) Select "OPEN" on No. 1 HP VALVE switch and check that the No. 1 T1 caption has gone out.

(2) Select "SHUT" on the No. 1 HP VALVE switch.

D. Test T1 Signal

(1) Confirm that on No. 1 engine system:

(a) The No. 1 HP VALVE switch is set to "SHUT".

(b) The No. 1 throttle lever is at idle.

(c) The No. 1 THROTTLE MASTER switch on the pilots' roof panel 4-211, is set to "OFF".

(2) Set the No. 1 HP VALVE switch to "OPEN", if it is undesirable to open the valve, trip the appropriate circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1 HP VALVE CONT	3-213	1K131	C1
ENG 2 HP VALVE CONT	1-213	2K131	C3

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 3 HP VALVE CONT	1-213	3K131	C4
ENG 4 HP VALVE CONT	3-213	4K131	C2

R (a) Check that the THROT fail caption (Red)
R illuminates and the gong sounds.

(3) Select "MAIN" on the No. 1 THROTTLE MASTER switch and check that the warnings cancel.

NOTE: A short period (seconds) will normally elapse before a fault becomes evident, by the illumination of a THROT caption and MWS warning.

(4) Set the No.1 HP VALVE switch to "SHUT", or reset the appropriate circuit breaker and check that the No.1 T1 failure warning light is illuminated.

(5) Return the No. 1 THROTTLE MASTER switch to "OFF".

(6) Repeat the checks in Operations (1), (2), (3), (4) for the Alternate amplifier in No. 2 engine system.

(7) Return the No. 2 THROTTLE MASTER switch to "OFF".

C. Conclusion

(1) Remove electrical ground power (Ref. 24-41-00).

TOTAL TEMPERATURE (T1) PROBE - INSPECTION/CHECK

1. General

If trouble shooting procedures indicate the possibility of a
R T1 probe defect, the probe plug pins must be examined under
R workshop conditions by a qualified inspector

2. Inspection/Check

A. Equipment and Materials

DESCRIPTION	PART NO.
R Magnifier, 10-20 times magnification	-
R R Insulation tester, range 0-12 Mohms	-
R R Electric oven, controllable to 130°C (266°F)	-
R R Xylene cleaning fluid (Ref.20-30-00, No.504)	-
R Gasket	Amphenol 62GB794
R Tweezers	-
R R Spring balance, 0.75 oz (22 gm)	-
R R 'Kimwipe' tissues	-

B. Prepare

(1) Enter the air intake and remove the T1 probe (Ref. 76-11-14, Removal/Installation).

C. Inspect

R R R (1) Inspect the probe electrical connector for damage and for contamination of the pins using a magnifier of 10-20 times magnification.

R R NOTE: Pin contamination takes the form of black marks, or a clear sticky substance.

(2) If there is any evidence of contamination, the following workshop cleaning procedure and insulation resistance check is to be carried out:

NOTE: If contamination of the pins is extensive, or if any probe has previously been removed from the same position for the same fault, the electrical receptacle must also be changed (Ref. Wiring Diagram Manual 20-42-34).

(a) Clean each individual pin, using a small piece of xylene-soaked 'Kimwipe' tissue or lint-free cloth held in tweezers.

CAUTION: EXCESSIVE USE OF CLEANING FLUID MAY RESULT IN A REDUCTION OF INSULATION RESISTANCE.

(b) Remove and discard the gasket at the base of the probe electrical connector and fit a new gasket (Ref.para.2A).

(c) Check the insulation resistance between the unit frame and pins A and B joined together. The resistance is to be 10 Mohm minimum at 500V DC.

(d) Heat the probe to 125°C (257°F) and check that there is an insulation resistance of 1 Mohm minimum, at 100V DC, between the following:

(d1) Unit frame and pins J,C,K,H joined together.

(d2) Unit frame and pins D,E,F,G joined together.

(d3) Pins C and D.

(d4) Pins A and K.

(3) Check the pin sockets in the aircraft electrical receptacle using a dummy male pin. If the pin is a loose fit (minimum pull-off 0.75 oz (22 gm)) replace receptacle (Ref. Wiring Diagram Manual 20-42-34).

D. Conclusion

(1) Install the T1 probe (Ref.76-11-14, Removal/Installation).

(2) Carry out the T1 probe Operational Test (Ref.76-11-14,

Adjustment/Test).

THROTTLE FRICTION DEVICE - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS CHAPTER 24-00-00.

1. General

The friction device is a clamping assembly which is adjusted to set the friction level in one throttle channel. There are four of these devices, and they are located inside the centre console at floor level.

The following Removal/Installation is described for No. 1 throttle channel only, the Removal/Installation of friction devices in other channels is to be accomplished in a similar manner.

2. Friction Device

A. Equipment and Materials

DESCRIPTION	PART NO
Torque spanner 0-50 lbf in (0-0.56 mdaN).	-
Screwdriver, torque limiting 0-80 lbf in (0-0.89 mdaN)	-
5/16 UNF socket spanner	-
Circuit breaker safety clips	-
Locking wire, corrosion resistant 0.028 in (0.71 mm) dia	-
Spring balance 0-10 lb (0-4.536 Kgf)	-
Locking pins (droop nose)	E925045031

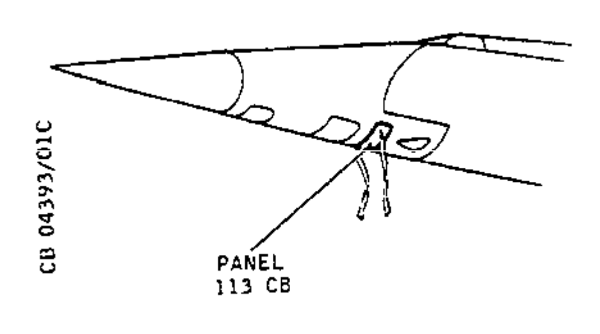
B. Prepare to Remove Friction Device (Ref. fig.401 and 402)

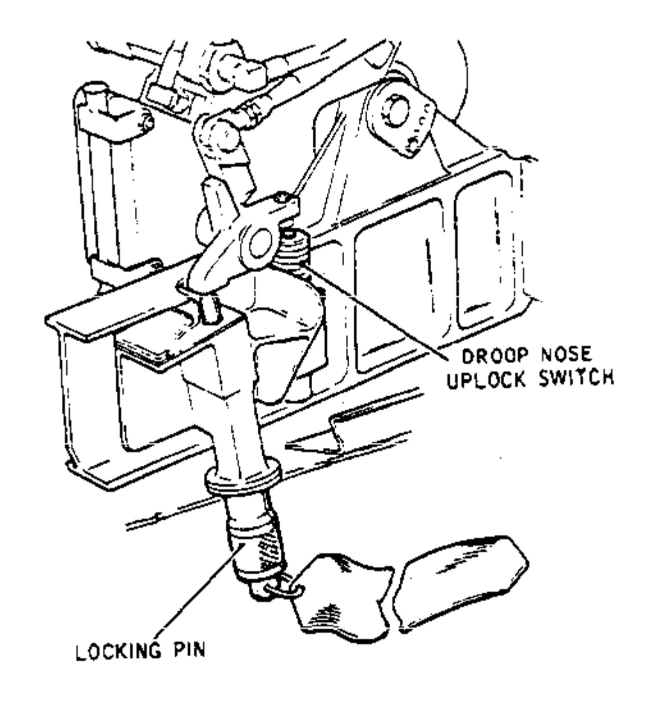
(1) Trip the appropriate circuit breakers and fit safety clips.

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SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALT THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C12
PP MGT LTS SUP	5-213	1E461	D 1
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALT THROT CONT	15-215	2K4	F15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	13-215	2K1541	B14
PP MGT LTS SUP	1-213	2E461	E 3
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALT THROT CONT	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6
REHEAT CONT	15-215	3K1542	D16
REHEAT AMP SUP	13-216	3K1541	B 7
PP MGT LTS SUP	1-213	3E461	E 4
ENG 4			
MAIN THRIT CONT	3-213	4K3	A 2
ALT THROT CONT	15-216	4K4	F11
REV THRUST CONT	3-213	4K331	D 2
REHEAT CONT	15-216	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7
PP MGT LTS SUP	5-213	4E461	D 2
AT SYS 1 SUP	13-215	1C179	C 6
AT SYNCHRO SYS 1 SUP	13-215	1C181	D 5
AT 1 CONT	1-213	1C180	Q12
AFCS 1 CONT	1-213	1C19	Q14
AT SYS 2 SUP	13-216	2C179	D16
AT SYNCHRO SYS 2 SUP	13-216	2C181	B17
AT 2 CONT	5-213	2C180	A14
AFCS 2 CONT	5-213	2C19	A12
CHART STOWAGE LTS SUP	15-216	L237	D12

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
NOSE 7 1/2° CONT	1-213	M12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17





Droop Nose Locking Pins
Figure 401

(2) Remove the centre console aft lefthand side panel:

(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilot's floor illumination at the receptacle identified U2026 on the panel.

(c) Lift the panel clear of the spigots and remove

the panel.

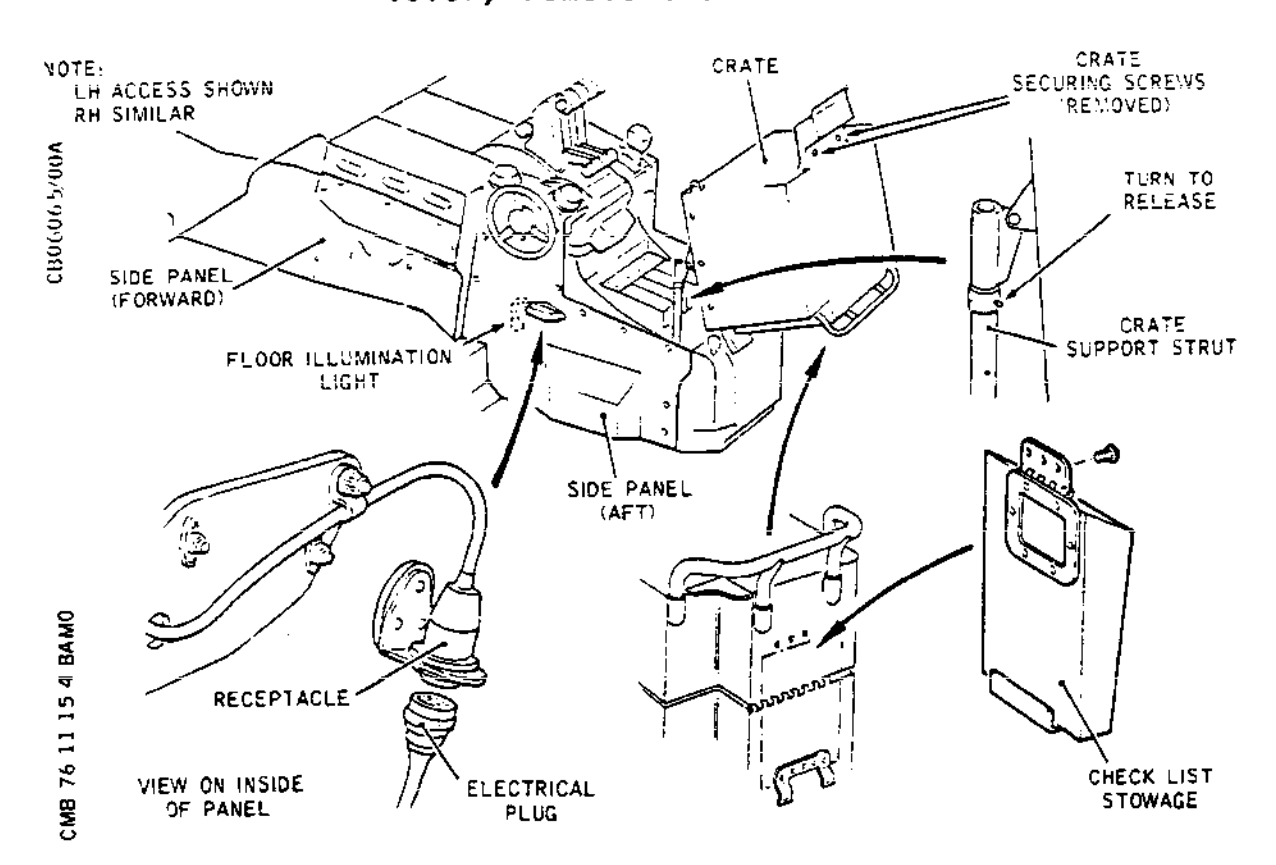
(3) Remove the droop nose emergency lever (Ref. Fig. 401).

NOTE: This can be done with the nose either up or down.

(a) If the nose is up, fit locking pins (2) in the droop nose mechanism.

(b) Remove the quick-release pin at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the lefthand side and depress the spring loaded pin on the forward end of the droop nose emergency lever; remove the lever.



R
Centre Console - Access
Figure 402

(4) Remove the centre console aft righthand side panel

in a manner similar to that described for the lefthand; the electrical plug identification is U2025.

(5) Remove the centre console forward side panels.

NOTE: To improve the access to the centre console it may be necessary to remove the co-pilot's seat (Ref. 25-11-21, Removal/Installation).

(6) Remove the screws securing the check list stowage, remove the stowage.

(7) Remove the screws securing the crate; hinge back the crate.

C. Remove Friction Device (Ref. Fig. 403).

(1) Disconnect the rod linkage on the No.1 throttle channel at the transmitter end.

(a) Break the locking wire securing the locknut at the quick-release coupling.

(b) Slacken the locknut.

(c) Unscrew the quick-release nut until the connection is broken.

(2) Slacken the friction device clamping bolt sufficiently to open the clamp and remove the friction device and rod linkage as a complete assembly.

(3) Remove the locking wire, slacken the locknut and unscrew the rod, the locking washers and locknut from the eye-end of the friction device.

D. Prepare to Install Friction Device

(1) Comply with the electrical safety precautions.

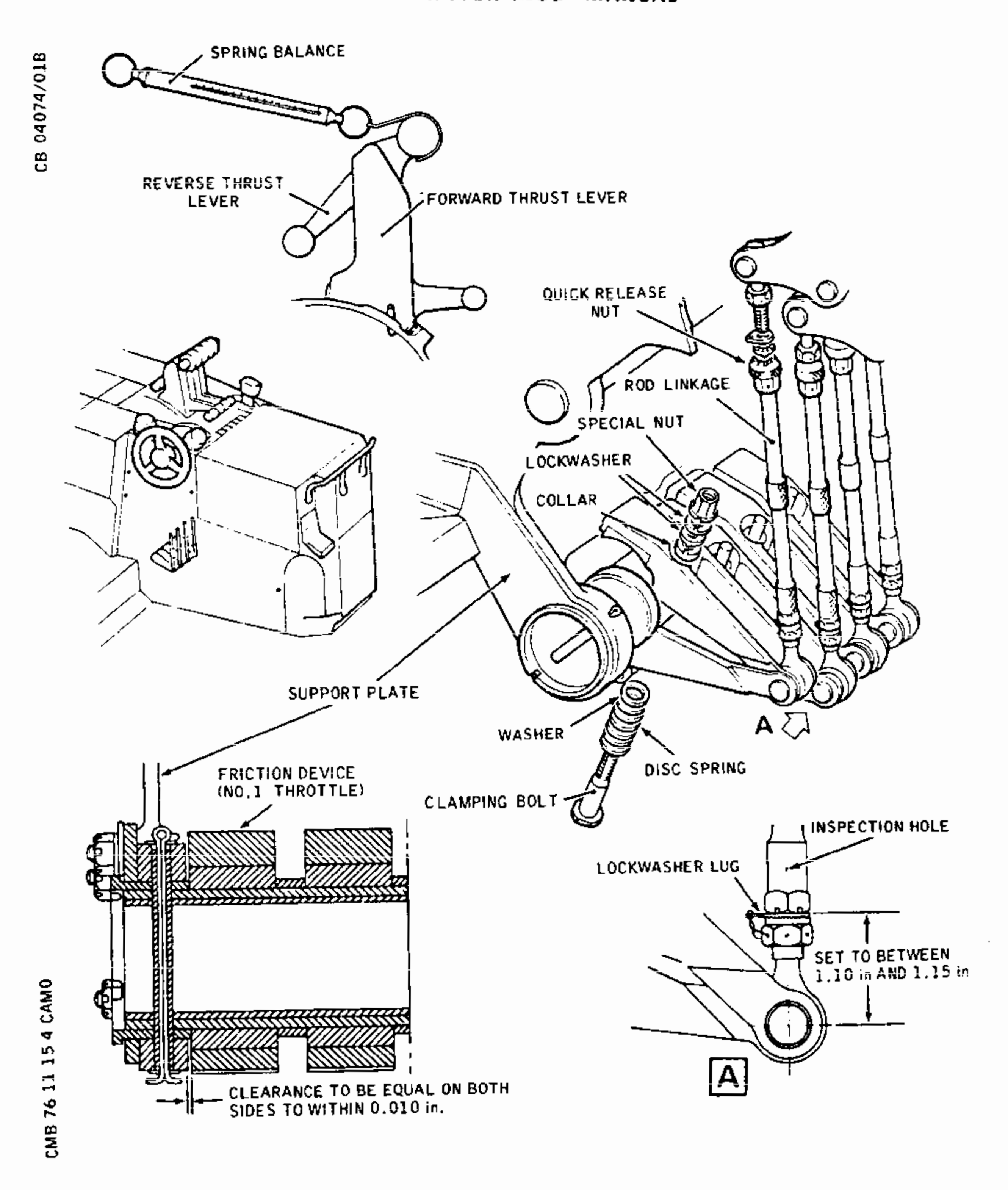
(2) Comply with the droop nose safety precautions.

(3) Ensure that the shaft is clean and undamaged; if necessary wipe with a clean tissue.

E. Install Friction Device (Ref. Fig. 403).

NOTE: All wire locking to 20-21-13.

(1) Secure the rod linkage to the friction device:



R Throttle Friction Device
Figure 403

(a) Screw the locknut, lockwashers and rod onto the eye-end of the replacement friction device.

CAUTION: THE LUGS ON THE LOCKWASHERS MUST FACE FORWARD.

(b) Adjust the rod until the distance between the bottom face of the rod and the pin centre of the friction device eye-end is between 1.10 and 1.15 in (27.94 and 29.21 mm).

CAUTION: HOLD THE ROD FIRMLY WITH A SPANNER WHEN TIGHTENING THE LOCKNUT TO ENSURE THAT THE LOAD IS NOT REACTED AGAINST THE BALLJOINT.

(c) Torque load the locknut to between 30 and 36 lbf in (0.34 and 0.4 mdaN), check that the setting has not altered, and wirelock the locknut.

(d) Ensure that the inspection hole in the rod is completely blocked by the threads (Ref. Detail A).

R (2) Ensure that the clamping bolt, disc spring, washer, collar, two locking washers and special nut securing the clamp are assembled on the friction device.

(3) Engage the friction device clamp with the shaft.

NOTE: The nut is to be finger tight only at this stage.

(4) Secure the quick-release nut at the top of the rod linkage.

(a) With a locknut and two lockwashers loosely assembled on the eye-end, engage the quick-
R release nut and screw in until the rod bottoms.

CAUTION: WHEN TIGHTENING THE QUICK-RELEASE NUT ENSURE THAT THE LOAD IS NOT REACTED AGAINST THE BALL JOINT.

(b) Hold the eye-end securely and torque load the
R quick-release nut to between 30 and 36 lbf in
R (0.34 and 0.4 mdaN).

(c) Arrange the locking washers in the slots of the

quick-release nut.

CAUTION: THE LUGS ON THE LOCKWASHERS MUST FACE FORWARD.

(d) With a spanner on the quick-release nut tighten the locknut and torque load to between 10 and 15 lbf in (0.11 and 0.17 mdaN) and wirelock.

(5) Check the gaps between the friction device and the support plate at both sides. The gaps are to be equal within 0.01 in(0.26 mm).

(6) Set throttle lever friction:

(a) Ensure that the No.1 throttle lever moves freely throughout its full travel.

(b) Attach a spring balance to the forward thrust lever as illustrated (Ref. Fig. 403).

(c) Tighten/slacken the clamping bolt on the No.1 friction device.

(d) Pull the forward thrust lever forward, using the spring balance. The force required to just move the lever from the idle stop is to be between 1.5 lbf and 1.7 lbf (0.675 Kgf and 0.765 Kgf).

NOTE: The applied force to be in the direction of travel and at right angles to the lever.

E. Conclusion

(1) Check that the area is clean, release the locking struts, and hinge forward the crate. Insert the two securing screws and, using the torq-set screwdriver, torque load them to between 70 and 80 lbf in (0.78 and 0.89 mdaN).

R (2) Engage the check list stowage with the rear of the crate, fit and tighten the securing screws.

(3) Replace the centre console aft righthand side panel:

(a) Check the panel seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilot's floor illumination at the receptacle identified U2025 on the panel.

(d) Using the torq-set screwdriver torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(4) Fit the droop nose emergency release lever on the righthand side of the centre console and insert the quick-release pin.

(5) Secure the centre console aft lefthand side panel in a manner similar to that described for the righthand panel, the electrical plug is identified U2026.

(6) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(7) If necessary, replace the co-pilot's seat (Ref. 25-11-21, Removal/Installation).

(8) Remove the safety clips and reset the circuit breakers previously tripped.

(9) Carry out a freedom of movement test on the throttle system (Ref. 76-11-00, Adjustment/Test).

(10) Remove the locking pins (2) from the droop nose.

R (11) Check the operation of the pilot's floor light.

FRICTION DEVICE - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

The friction device, located in the pilots' centre console, is periodically adjusted to provide a pre-determined friction on each forward thrust throttle lever. The means of adjustment is similar for all throttle levers.

2. Adjustment

A. Equipment and Materials

DESCRIPTION	PART NO.
Screwdriver, torque limiting 0-80 lbf in (0-0.89 mdaN)	-
5/16 UNF socket spanner	-
Locking pins (droop nose)	E925045031
Circuit breaker safety clips	-
Corrosion-resistant steel wire 0.028 in (0.71 mm) dia	-
Spring balance 0-10 lb (0-4.536 Kgf)	-

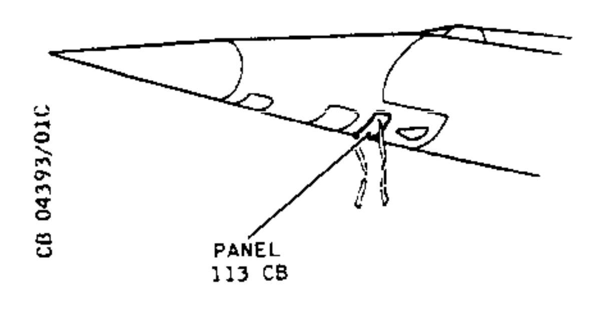
B. Prepare to Adjust (Ref. Fig.501 and 502)

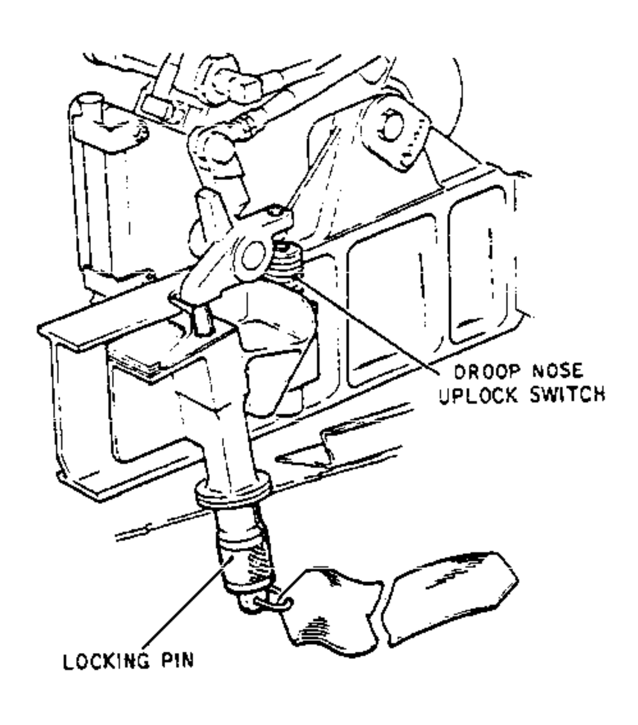
(1) Trip the appropriate circuit breakers and fit safety clips.

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SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALT THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C12
PP MGT LTS SUP	5-213	1E461	D 1
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALT THROT CONT	15-215	2K4	F15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	13-215	2K1541	B14
PP MGT LTS SUP	1-213	2E461	E 3
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALT THROT CONT	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6
REHEAT CONT	15-215	3K1542	D16
REHEAT AMP SUP	13-216	3K1541	B 7
PP MGT LTS SUP	1-213	3E461	E 4
ENG 4			
MAIN THROT CONT	3-213	4K3	A 2
ALT THROT CONT	15-216	4K4	F11
REV THRUST CONT	3-213	4K331	D 2
REHEAT CONT	15-216	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7
PP MGT LTS SUP	5-213	4E461	D 2
AT SYS 1 SUP	13-215	1C179	C 6
AT SYNCHRO SYS 1 SUP	13=215	1C181	D 5
AT 1 CONT	1-213	1C180	Q12
AFCS 1 CONT	1-213	1C19	Q14
AT SYS 2 SUP	13-216	2C179	D16
AT SYNCHRO SYS 2 SUP	13-216	2C181	B17
AT 2 CONT	5-213	2C180	A14
AFCS 2 CONT	5-213	2C19	A12
CHART STOWAGE LTS SUP	15-216	L237	D12

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
NOSE 7 1/2° CONT	1-213	M12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17





CMB 76 11 15 5 AAMO

Droop Nose Locking Pins
Figure 501

(2) Remove the centre console aft left-hand side panel:

(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilots' floor illumination at the receptacle identified U2026 on the panel.

(c) Lift the panel spigots clear of the floor.

R Remove the panel.

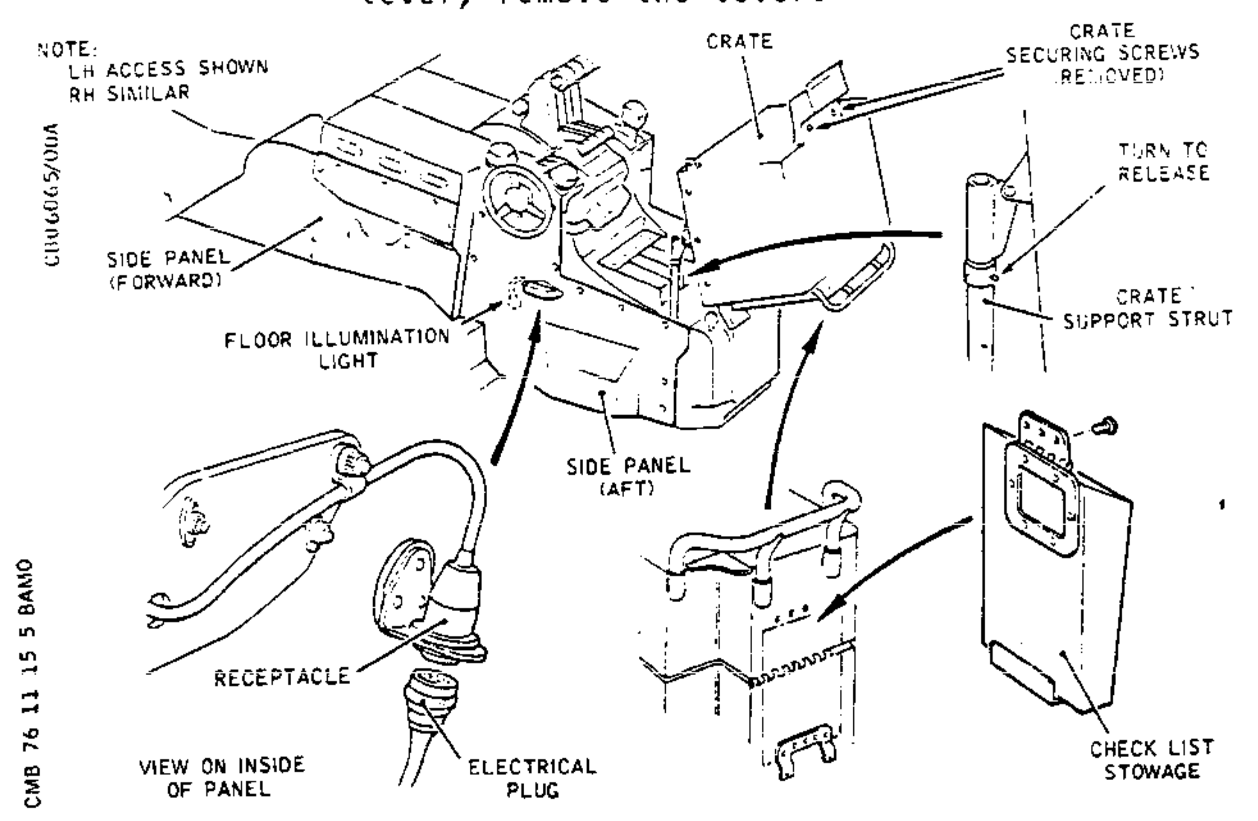
(3) Remove the droop nose emergency lever (Ref. Fig. 501)

NOTE: This can be done with the nose either up or down.

(a) If the nose is up fit safety pins (2) in the droop nose mechanism.

(b) Remove the quick-release pin at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the left-hand side and depress the spring-loaded pin on the forward end of the droop nose emergency lever; remove the lever.



R Centre Console - Access
Figure 502

(4) Remove the centre console aft right-hand side panel in a manner similar to that described for the

left-hand; the electrical plug identification is U2025.

(5) Remove the centre console forward side panels.

C. Adjust (Ref. Fig. 503)

(1) Tighten or slacken the clamping bolt nut on the No.1 throttle friction device.

(2) Check the friction on No. 1 throttle lever as in para. 3.

(3) Re-adjust the clamping bolt, if necessary.

D. Conclusion

(1) Check that the area is clean and replace the centre console aft right-hand side panel.

(a) Loosely engage the panel.

(b) Connect the pilots' floor illumination at the receptacle identified U2025 on the panel.

R (c) Check that the area is clean and close the panel. Torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(2) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the quick-release pin.

(3) Secure the centre console aft left-hand side panel in a manner similar to that described for the right-hand panel, the electrical plug is identified U2026.

(4) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(5) Remove the safety clips and reset the circuit breakers previously tripped.

(6) Remove the droop nose locking pins (2).

R (7) Check the operation of the pilot's floor lights.

3. Test

A. Equipment and Materials

DESCRIPTION	PART NO
Spring balance 0-10 lbf (0-4.536 kgf)	-
Circuit breaker safety clips	-

B. Prepare to Test

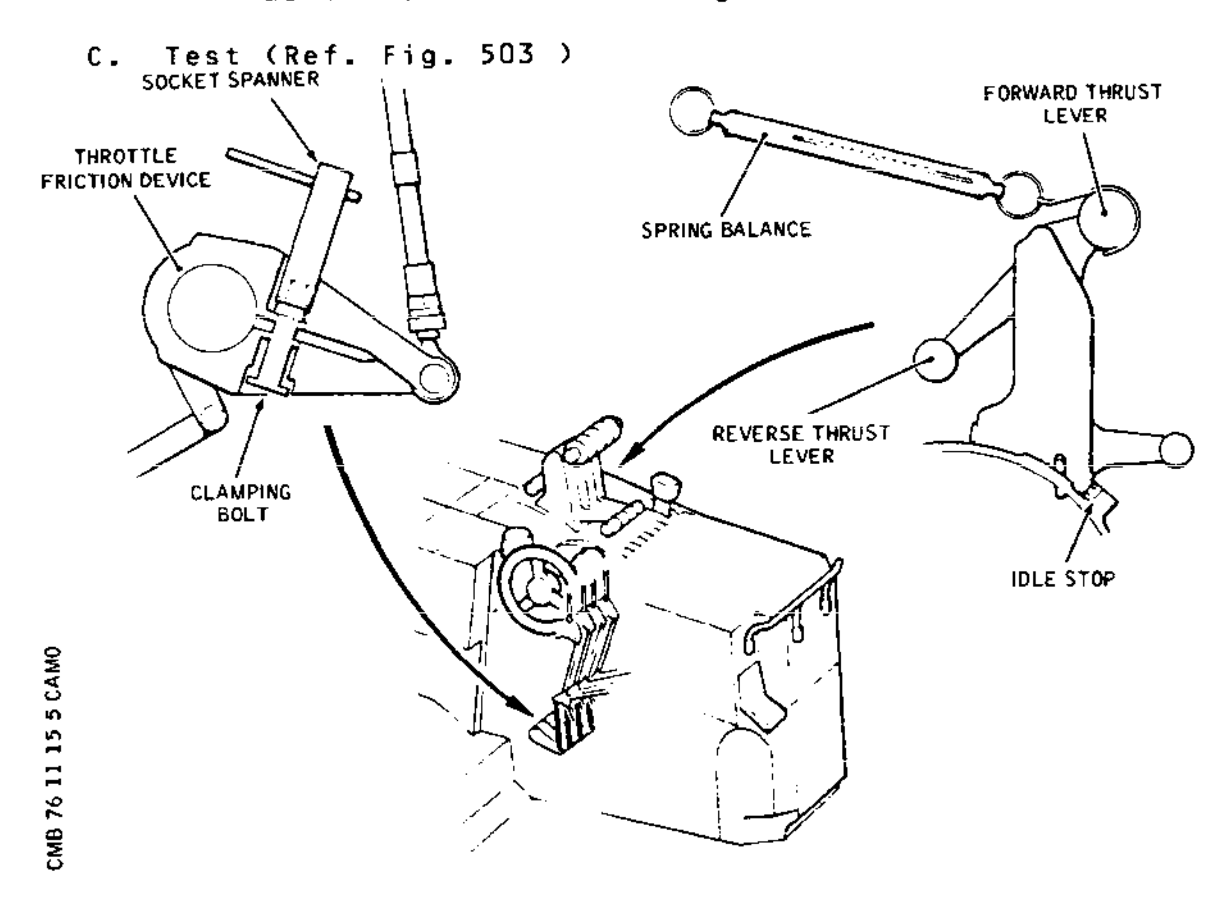
(1) Trip the appropriate circuit breakers and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALT THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C12
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALT THROT CONT	15-215	2K4	E15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	15-215	2K1541	B15
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALT THROT CONT	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6
REHEAT CONT	15-215	3K1542	D16
REHEAT AMP SUP	13-216	3K1541	B 7
ENG 4			
MAIN THROT CONT	3-213	4K3	A 2
ALT THROT CONT	15-216	4K4	F11

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
REV THRUST CONT	3-213	4K331	D 2
REHEAT CONT	15-216	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7

(2) Attach a spring balance to the forward thrust lever as illustrated (Ref. Fig. 503).

C. Test (Ref. Fig. 503)



Throttle Friction Adjustment
Figure 503

(1) Pull the forward thrust lever forward, using the spring balance. The force required to just move the lever from the idle stop is to be between 1.5 lbf and 1.7 lbf (0.675 kgf and 0.765 kgf).

NOTE: The applied force is to be in the direction of travel and at right angles to the lever.

(2) Re-adjust the friction device, if necessary (Ref. para. 2).

D. Conclusion

(1) Remove the spring balance.

(2) Remove the safety clips and set the circuit breakers previously tripped.

(3) Check the freedom of movement of the throttles (Ref. 76-11-00, Adjustment/Test).

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THROTTLE LEVER ASSEMBLY - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

Each of the four throttle lever assemblies located in the centre console, comprises a forward thrust lever and a reverse thrust lever as an integrated assembly. Detailed in this topic is the procedure for the Removal/Installation of No. 1 throttle lever assembly and the settings and tests required during installation. The other throttle lever assemblies are removed and installed in a similar manner.

When removing No.1 or 4 throttle levers it is necessary to disconnect the auto-throttle leads. An auto-throttle disconnect push-button may be removed in accordance with 22-31-63, Removal/Installation.

The throttle levers are not interchangeable. Removal of a thrust reverse lever necessitates the removal of the complete throttle lever assembly.

2. Throttle Lever

A. Equipment and Materials

DESCRIPTION	PART NO.
Optical measuring tool	QV6-A01
Gauge position	QG6-A01
Circuit breaker safety clips	-
Screwdriver, torque limiting range 0-0.89 mdaN)	
Corrosion resistant steel wire 0.028 in (0.71 mm) dia	-
Locquic N (Ref.20-30-00, No.120)	-
R Loctite H (Ref. 20-30-00, No 113)	-
Loctite E(Ref 20-30-00, No.112)	-
Vidaflex	BAS 7857M017C

DESCRIPTION	PART NO.
R Braided cable sleeving	BAS 8699
Locking pins (droop nose)	E925045031

B. Prepare to Remove Lever (Ref. Fig.401 and 402).

NOTE: To improve access to the centre console it may be necessary to remove the co-pilot's seat (Ref. 25-11-21, Removal/Installation).

(1) Trip the appropriate circuit breakers and secure them with safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALT THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C12
PP MGT LTS SUP	5-213	1E461	D 1
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALT THROT CONT	15-215	2K4	F15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	13-215	2K1541	B14
PP MGT LTS SUP	1-213	2E461	E 3
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALT THROT CONT	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6
REHEAT CONT	15-215	3K1542	D16
REHEAT AMP SUP	13-216	3K1541	B 7
PP MGT LTS SUP	1-213	3E461	E 4

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
ENG 4			
R MAIN THROT CONT	3-213	4K 3	A 2
ALT THROT CONT	15-216	4K 4	F11
REV THRUST CONT	3-213	4K 331	D 2
REHEAT CONT	15-216	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7
PP MGT LTS SUP	5-213	4E 461	D 2
AT SYS 1 SUP	13-215	1C 179	C 6
AT SYNCHRO SYS 1 SUP	13-215	1C 181	D 5
AT 1 CONT	1-213	1C 180	Q12
AFCS 1 CONT	1-213	1C 19	Q14
AT SYS 2 SUP	13-216	2C 179	D16
AT SYNCHRO SYS 2 SUP	13-216	2C 181	B17
AT 2 CONT	5-213	2C 180	A14
AFCS 2 CONT	5-213	2C 19	A12
CHART STOWAGE LTS SUP	15-216	L 237	D12
NOSE 7 1/2° CONT	1-213	M 12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M 13	Q17

(2) Remove the centre console aft left-hand side panel:

(a) Release the screws securing the panel.

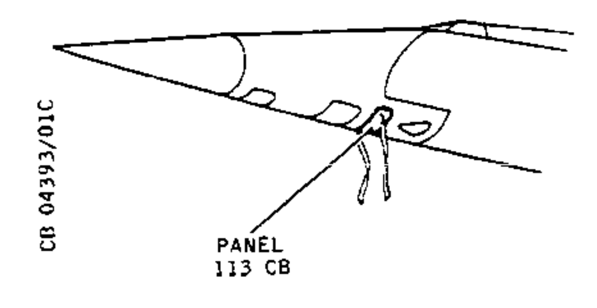
(b) Disconnect the electrical plug for the pilot's floor illumination at the receptacle identified U2026 on the panel.

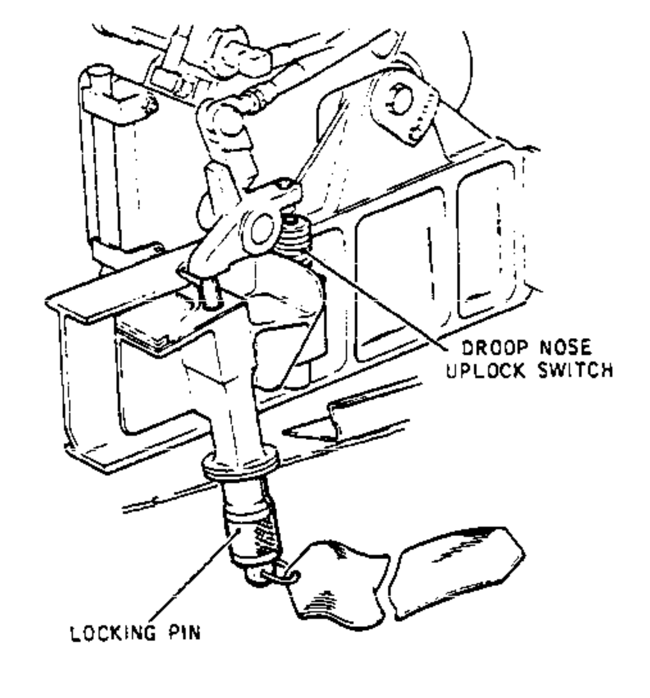
(c) Lift the panel spigots clear of the floor and remove the panel.

(3) Remove the droop nose emergency lever (Ref. Fig.401).

NOTE: This can be carried out with the nose either up or down.

(a) If the nose is up, fit locking pins (2) in the droop nose mechanism.





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Droop Nose Locking Pins
R Figure 401

(b) Remove the quick-release pin at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the lefthand side and depress the spring-loaded pin on the forward end of the droop nose emergency lever; remove the lever.

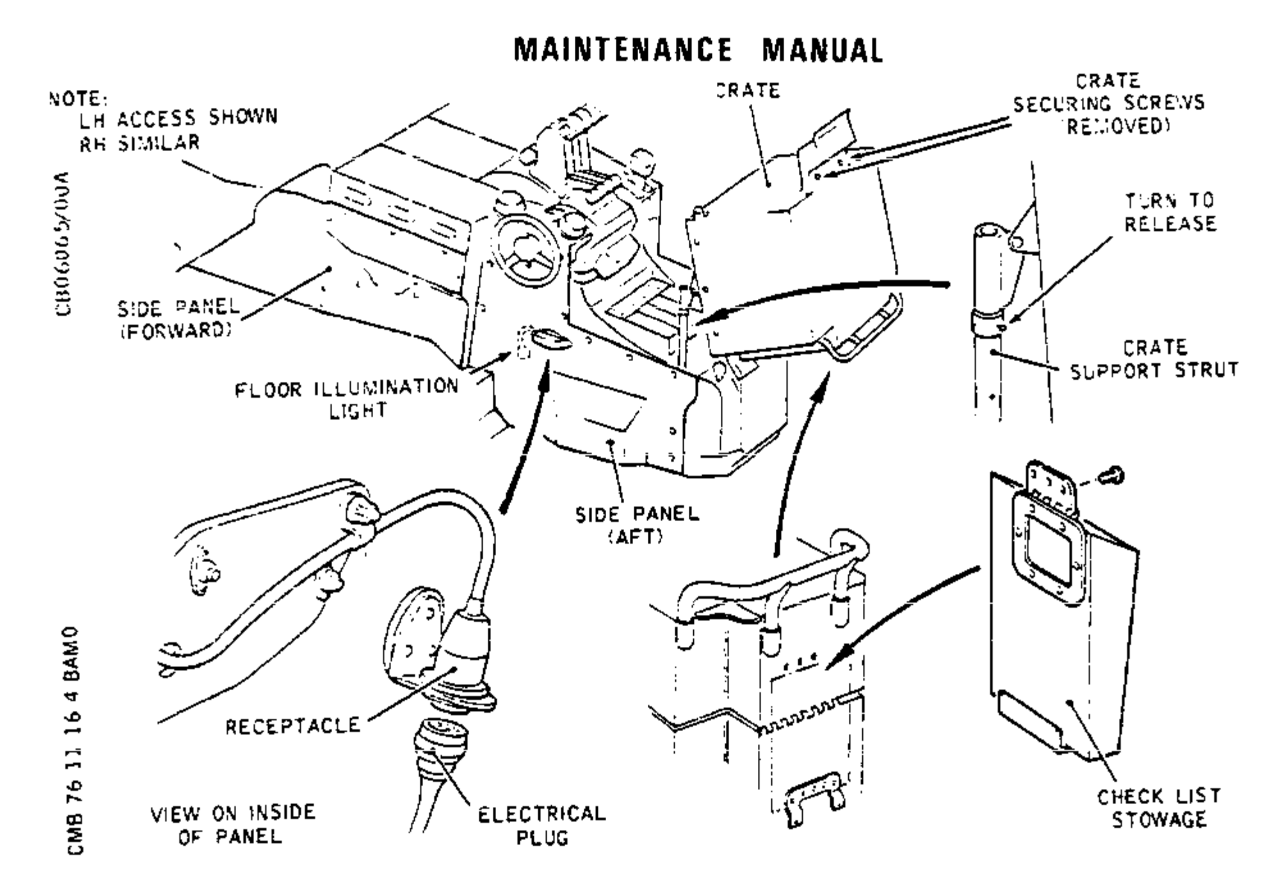
(4) Remove the centre console aft right-hand side panel in a manner similar to that described for the left-hand; the electrical plug identification is U2025.

(5) Remove the centre console forward side panels.

(6) Remove the screws securing the check list stowage; remove the stowage.

(7) Remove the screws securing the crate; hinge back the crate.

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Centre Console - Access.
R Figure 402

C. Remove the Lever (Ref. Fig. 403).

(1) Unscrew the knurled nuts to extract the four throttle transmitters (Ref. 76-11-12); remove transmitters.

(2) Remove the bolts securing the reverse thrust switch pack mounting bracket. Move the mounting bracket and switch pack rearwards, to the full extent of the electrical leads, and lay the switch pack face downwards. Do not disturb the electrical connections.

(3) Remove the throttle gate forward stop and aft mounting assemblies:

R (a) Remove the eight screws securing the LH and RH
R linkplates.

R (b) Remove the remaining two screws in the forward
R stop assembly; remove the assembly.

R (c) Remove the bolts securing the throttle gate to the aft mounting.

R (d) Remove the screws securing the aft mounting to the centre console casting; remove the mounting.

R (e) With the throttle levers fully forward, remove the throttle gate by manoeuvring it rearward.

(4) Release the fasteners securing the SELCAL control unit forward of the throttle gate; remove the unit and lay it to one side; do not disturb the electrical connections.

(5) Disconnect the wiring from the auto-throttle disconnect switch at terminal block UM2073, Nos 1,2,3,4,6 and 8, on the left-hand side of the console. Remove the loom clipping as necessary to facilitate the withdrawal of the leads.

(6) Remove the locking wire and disconnect the No.1 operating lever to the forward thrust switch box at the turnbuckle (count and record the number of turns).

(7) Remove the locking wire and disconnect the No. 1 throttle rod linkage, to the transmitter, at the top end (count and record the number of turns).

(8) Remove sub panel 3 on the right-hand side of the console:

(a) Disconnect the plug UA 2063.

(b) Remove the bolt in the solenoid baulk O/ride lever.

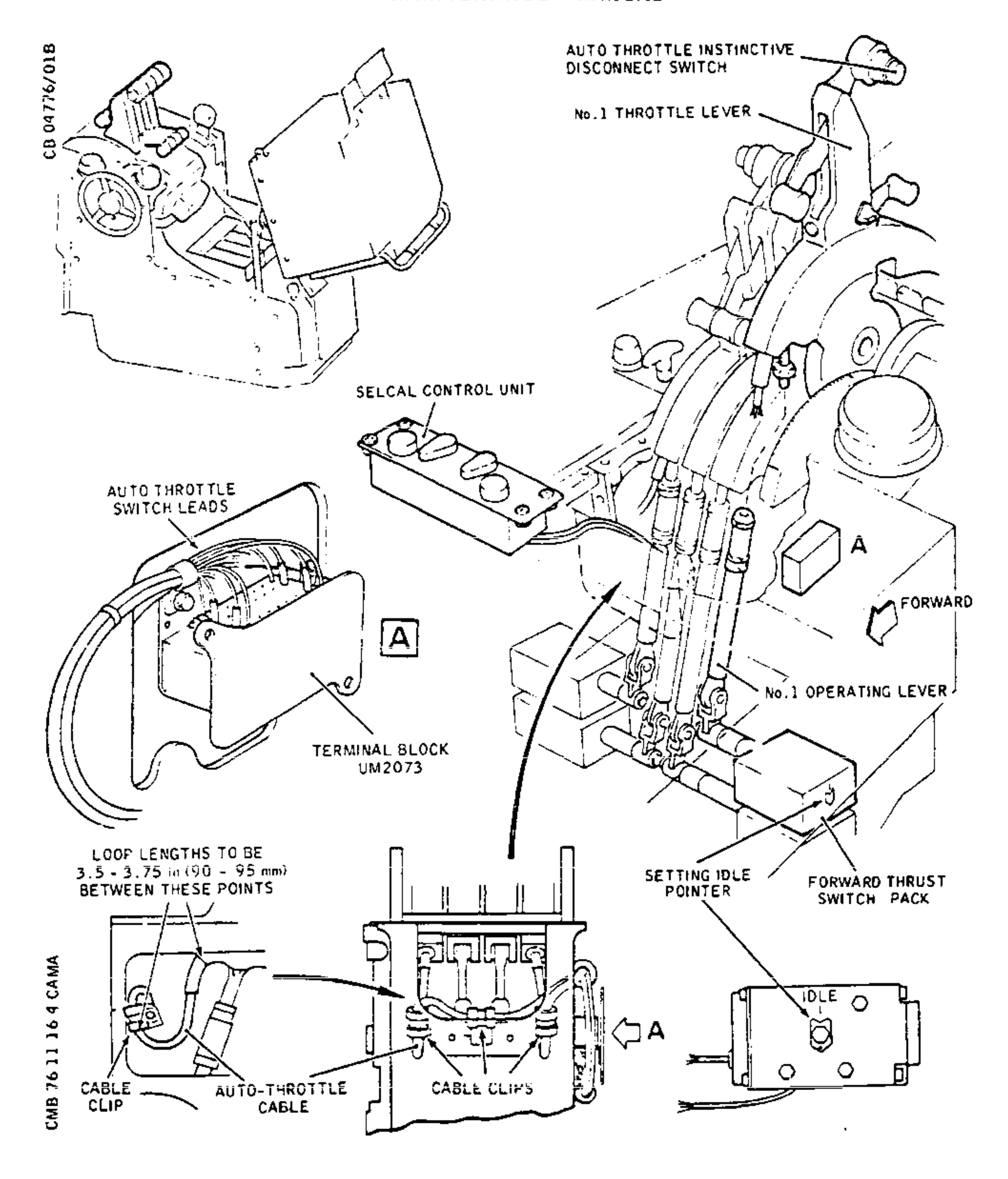
(c) Remove the three panel base securing screws, remove the panel base.

(d) Remove the panel securing screws, and remove the panel. Do not disturb the electrical leads.

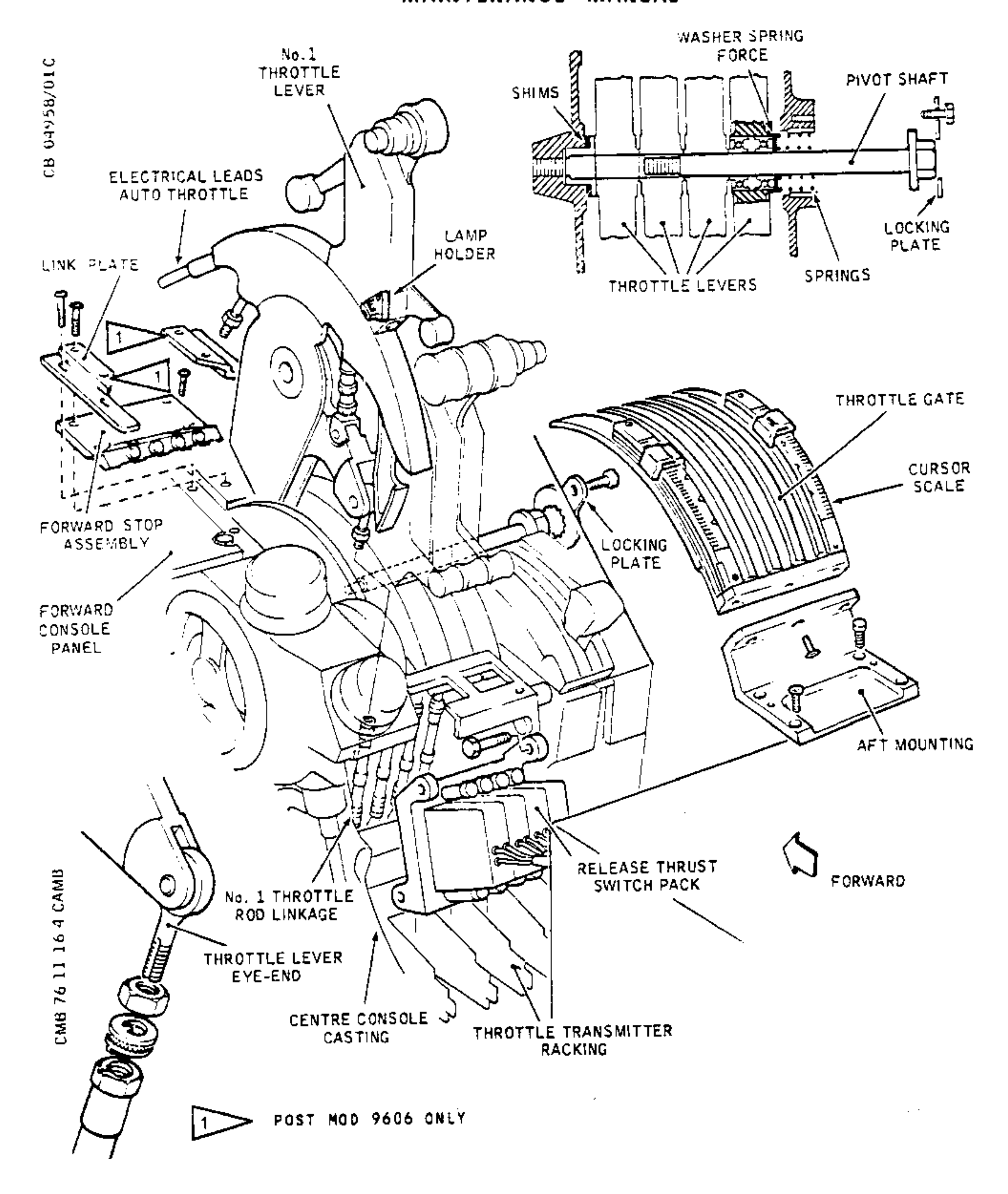
(9) Remove the throttle lever:

(a) Remove the locking wire and the two bolts securing the locking plate at the right-

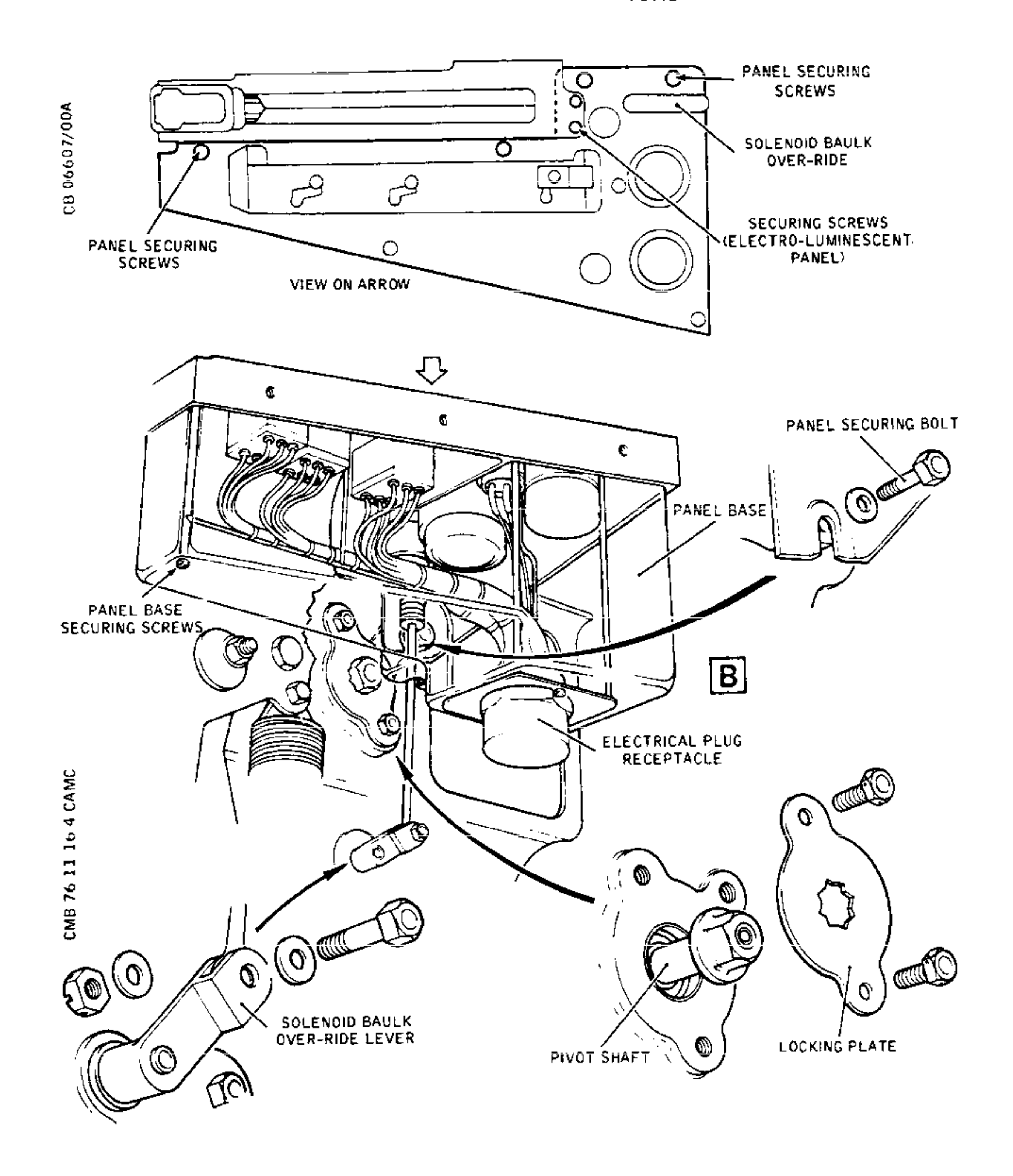
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Throttle Lever - Removal/Installation
(Sheet 1 of 3)
Figure 403



Throttle Lever - Removal/Installation
(Sheet 2 of 2)
Figure 403



Throttle Lever - Removal/Installation
(Sheet 3 of 3)
Figure 403

hand side of the centre console; remove the plate.

(b) Unscrew and slowly withdraw the pivot shaft sufficiently to permit No.1 lever assembly to be removed; remove the assembly.

NOTE: 1. Take care not to remove flanged bush and shims.

2. When removing No.4 throttle lever ensure that the springs and washer remain in place.

(c) Temporarily replace the pivot shaft.

D. Prepare to Install Lever

(1) Comply with the electrical safety precautions.

(2) Check the area in the centre console for cleanliness.

E. Install Lever (Ref. Fig. 403)

NOTE: 1. All electrical connections must be clean and undamaged and must be made in accordance with the cable identification and the applicable wiring diagram.

2. All wire locking to 20-21-13.

(1) Position the lever assembly and refit the pivot shaft:

(a) Unscrew and slowly withdraw the pivot shaft sufficiently to permit the lever assembly to be located in the centre console. Engage, tighten and torque load the pivot shaft to between 150 and 180 lbf in (1.68 and 2.01 mdaN).

(b) Locate the locking plate and secure it with the bolts, Torque load each bolt to between 50 and 60 lbf in (0.56 and 0.67 mdaN) and lock the bolts to each other with wire.

(2) Connect the instinctive disconnect switch.

NOTE: The loom is to be sheathed in Vidaflex where it may contact a metal surface.

(a) Secure the loom to the centre console casting at the clip positions with a P-clip, bolt and washer.

CAUTION: THE LOOP LENGTH IS TO BE 3.50 TO 3.75 IN (88.9-95.25 mm).

(b) Torque load each bolt to between 25 and 30 lbf in (0.285 and 0.34 mdaN), and wirelock to the adjacent lug.

(c) Connect the switch leads to the terminal block identified UM 2073, Nos. 1,2,3,4,6 and 8, on the left-hand side of the console (Ref. Fig. 403).

(d) Check that the throttle lever moves freely over the full range of movement.

(3) Temporarily assemble the throttle gate assembly:

(a) With the throttle levers fully forward position the throttle gate.

(b) Engage the forward stop assembly on the locating dowels and secure it with the two forward bolts.

R ** ON A/C 001-003, 005-007

(c) Engage the LH link plate with the centre console forward panel and forward stop and secure it with the four screws. Repeat this procedure for the RH linkplate.

R ** ON A/C 004

R (c) Not applicable

R (d) Engage the throttle gate in the slots of the forward stop assembly.

R (e) Engage the aft mounting with the centre console casting and secure it with the two screws and two bolts.

R (f) Secure the throttle gate to the aft mounting with a special bolt and a spacer at the three positions.

R (g) Secure the two smaller bolts in the forward stop assembly; which secure the throttle gate.

R ** ON A/C 001-003, 005-007

(4) Check the clearance between the throttle levers and the sides of the throttle gate. The smallest of the gaps to the left of the levers, and the smallest of the gaps to the right of the levers,

must be equal to within 0.003 in (0.08 mm) throughout full travel of each throttle lever. If necessary adjust as follows:

(a) Remove the throttle gate, link plates, forward stop and aft mounting assembly.

(b) Withdraw the pivot shaft.

(c) Remove the bush in the pivot shaft recess, at the left-hand side of the centre console casting, and add or delete shims as necessary, refit the bush.

(d) Insert the pivot shaft.

(e) Replace the throttle gate, linkplates, forward stop and aft mounting assembly.

(f) Recheck the clearance between each side of the lever and the gate.

R ** ON A/C 004

R (4) Check the clearance between the throttle levers and the sides of the throttle gate. The smallest of the gaps to the left of the levers, and the smallest of the gaps to the right of the levers, must be equal to within 0.003 in (0.08 mm) throughout full travel of each throttle lever. If necessary adjust as follows:

R (a) Remove the throttle gate, forward stop and aft mounting assembly.

R (b) Withdraw the pivot shaft.

R (c) Remove the bush in the pivot shaft recess, at the left-hand side of the centre console casting, and add or delete shims as necessary, refit the bush.

R (d) Insert the pivot shaft.

R (e) Replace the throttle gate, forward stop and aft mounting assembly.

R (f) Recheck the clearance between each side of the lever and the gate.

R ** ON A/C 001-003, 005-007

(5) Remove the screws and bolts in the forward stop, the throttle gate and the aft mounting, coat them with Loquic N and Loctite Grade E (20-25-11) and refit:

NOTE: This does not include the four screws, two in each linkplate, which secure the link plates to the centre console.

(a) Torque load the four large bolts securing the forward stop assembly to between 50 and 60 lbf in (0.56 and 0.67 mdaN).

(b) Torque load the four screws securing the link-plates to the forward centre console panel to between 30 and 40 lbf in (0.34 and 0.45 mdaN).

(c) Torque load the three bolts securing the throttle gate to the aft mounting to between 60 and 70 lbf in (0.67 and 0.78 mdaN) and lock the bolts to each other with locking wire.

(d) Torque load the two bolts securing the forward end of the throttle gate in the forward stop assembly to between 40 and 45 lbf in (0.45 and 0.51 mdaN).

(e) Torque load the bolts and screws in the aft mounting to between 25 and 30 lbf in (0.29 to 0.34 mdaN).

** ON A/C 004

(5) Remove the screws and bolts in the forward stop, the throttle gate and the aft mounting, coat them with Loquic N and Loctite grade E (20-25-11) and refit:

(a) Torque load the four large bolts securing the forward stop assembly to between 50 and 60 lbf in (0.56 and 0.67 mdaN).

(b) Torque load the three bolts securing the throttle gate to the aft mounting to between 60 and 70 lbf in (0.67 and 0.78 mdaN) and lock the bolts to each other with locking wire.

(c) Torque load the two bolts securing the forward end of the throttle gate in the forward stop assembly to between 40 and 45 lbf in (0.45 and 0.51 mdaN).

(d) Torque load the bolts and screws in the aft

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mounting to between 25 and 30 lbf in (0.29 to 0.34 mdaN).

(6) Check the minimum and maximum stop settings on all four throttle levers to ensure that the settings have not altered (Ref. 76-11-00, Adjustment/Test).

NOTE: Any adjustment to these settings will necessitate a check on the forward and reverse thrust switches on the same throttle assembly.

R (7) If a new No.1 or No.4 forward thrust lever is
R installed or if the cursor light on the lever is
R damaged, install a new cursor light lamp holder on
R the lever in accordance with the instructions given
R in para.3.

R (8) Connect the No. 1 throttle linkage rod:

(a) Thread the locknut and lockwashers onto the eye-end of the throttle lever.

(b) With the quick-release nut slackened off, engage the rod and screw on a previously determined number of turns (para.C); do not lock.

R (9) Set the No. 1 throttle linkage rod:

CAUTION: THE LUG ON THE LOCKWASHER AT THE LOWER END OF THE ROD MUST FACE FORWARD.

(a) Temporarily replace the reverse thrust switch pack.

(b) Insert the optical measuring tool for measuring rotation of the transmitter drive coupling (Ref. 76-11-00, Adjustment/Test).

(c) Hold the No. 1 forward thrust lever lightly against the idle stop, and check the reading
R on the tool, it should be between 35 deg 50 min
R and 36 deg. 10 min. Where this reading is
not achieved adjust the rod.

(d) Turn the rod clockwise or counter clockwise to adjust the rod length, until a reading of
R between 35 deg 50 min and 36 deg 10 min is
R obtained on the tool.

(e) At the top of the rod, arrange the locking washers in the slot of the rod (one in the slot in the rod and one in the slot in the eye-end and, with the rod held firmly, tighten and torque load the left-hand threaded locknut to between 30 and 36 lbf in (0.34 and 0.40 mdaN).

CAUTION: WHEN TIGHTENING THE QUICK RELEASE NUT ENSURE THAT THE LOAD IS NOT REACTED AGAINST THE BALL JOINT.

(f) At the bottom of the rod hold the eye-end firmly and tighten the quick-release nut until the rod ends contact. Torque load it to between 30 and 36 lbf in (0.34 and 0.40 mdaN).

(g) Arrange the locking washers in the slots of the quick release nut.

(h) With a spanner on the quick-release nut torque tighten the locknut to between 10 and 15 lbf in (0.11 and 0.17 mdaN).

(i) Check that the rod end blocks the inspection hole in the rod.

R (j) Check that the tolerance of 35 deg 50 min to 36 deg 10 min includes the system backlash by moving the forward thrust lever forward and then back against the idle stop.

(k) Move the forward thrust lever fully forward in the gate and hold it lightly against the stop. The reading on the tool should be between 0 deg. and minus 0 deg.20 min; adjust the forward stop if necessary.

(l) Lock the locknuts at both the top and the bottom of the rod with locking wire.

(m) Repeat the checks in (j) and (k) above on all four levers.

(n) Remove the optical measuring tool.

R (10) Connect the No. 1 operating lever to the forward thrust switch box:

(a) Thread the locknut and lockwashers onto the

eye-end of the throttle lever.

(b) With the turnbuckle lock-nuts slackened off. engage the operating lever with the eye-end of the throttle lever and screw on a previously determined number of turns (para C.)

(c) With the No. 1 forward thrust lever held lightly against the idle stop adjust on the operating lever until the pointer on the forward thrust switch box is aligned with the mark engraved IDLE.

(d) Lock the locknuts and torque load them to between 50 and 60 lbf in (0.56 and 0.67 mdaN) and wirelock.

CAUTION: WHEN TIGHTENING THE LOCKNUTS ENSURE THAT THE LOAD IS NOT REACTED AGAINST THE BALL JOINT.

(e) Check that the inspection holes are blocked by the rod end.

(f) Check the individual settings of the forward thrust switches (Ref. 76-15-12, Adjustment/Test) and adjust as necessary.

R (11) Remove the mounting bracket and the reverse thrust switch pack (fitted earlier) and install, as follows, with the reverse thrust levers in the fully off position and the forward thrust levers
R against the idle stops:

(a) Engage the mounting bracket for the reverse thrust switch pack with the casting; ensure that the bushes are in place in the casting in the top two holes and the bottom right hand hole. Secure the mounting bracket at the bottom with bolts; torque load each bolt to between 50 and 60 lbf in (0.56 and 0.67 mdaN) and lock with wire to the drilling in the casting.

(b) Secure each side of the mounting bracket at the top with a bolt, washer and a nut. Torque load each bolt to between 50 and 60 lbf in (0.56 and 0.67 mdaN) and lock it with a split pin.

E. Conclusion

(1) Check that the area is clean, release the locking struts, and hinge forward the crate. Insert the two securing screws and torque load them to between 70 and 80 lbf in (0.78 and 0.89 mdaN).

(2) Engage the check list stowage with the rear of the crate, fit and tighten the securing screws.

(3) Replace the centre console aft right-hand side panel:

(a) Check the panel seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilot's floor illumination at the receptacle identified U2025 on the panel.

(d) Torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(4) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the quick-release pin.

(5) Secure the centre console aft left-hand side panel in a manner similar to that described for the right-hand panel, the electrical plug is identified U 2026

(6) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(7) If necessary, replace the copilot's seat (Ref. 25-11-21, Removal/Installation).

(8) Remove the locking pins (2) from the droop nose.

(9) Remove the safety clips and reset the circuit breakers previously tripped.

(10) Carry out an Operational test on the throttles (Ref. 76-11-00, Adjustment/Test).

R 3. Bonding Cursor Light Lampholder to Forward Thrust Lever

R A. Equipment and Materials

DESCRIPTION	PART NO.
R Adhesive RTV731 (Ref.20-30-00, No. 364)	-
R Adhesive (Ref. 20-25-14)	-
R Paint, dark grey,BS 381C shade 632 (Ref.20-30-00,No.674)	-
R Non-metallic (Tufnol) scraper	-
R Protective sheet	-
R Kimwipe tissues	-

R B. Prepare (Ref. Fig. 404)

R (1) Trip the appropriate circuit breaker and secure them with safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALT THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C12
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALT THROT CONT	15-215	2K4	F15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	13-215	2K1541	B14
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALT THROT CONT	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6
REHEAT CONT	15-215	3K1542	D16

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
REHEAT AMP SUP	13-216	3K1541	B 7
ENG 4			
R MAIN THROT CONT	3-213	4K 3	A 2
ALT THROT CONT	15-216	4K 4	F11
REV THRUST CONT	3-213	4K 331	D 2
REHEAT CONT	15-216	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7
AT SYS 1 SUP	13-215	1C 179	C 6
AT SYNCHRO SYS 1 SUP	13-215	1C 181	D 5
AT 1 CONT	1-213	1C 180	Q12
AFCS 1 CONT	1-213	1C 19	Q14
AT SYS 2 SUP	13-216	2C 179	D16
AT SYNCHRO SYS 2 SUP	13-216	2C 181	B17
AT 2 CONT	5-213	2C 180	A14
AFCS 2 CONT	5-213	2C 19	A12
CHART STOWAGE LTS SUP	15-216	L 237	D12
NOSE 7 1/2° CONT	1-213	M 12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M 13	Q17

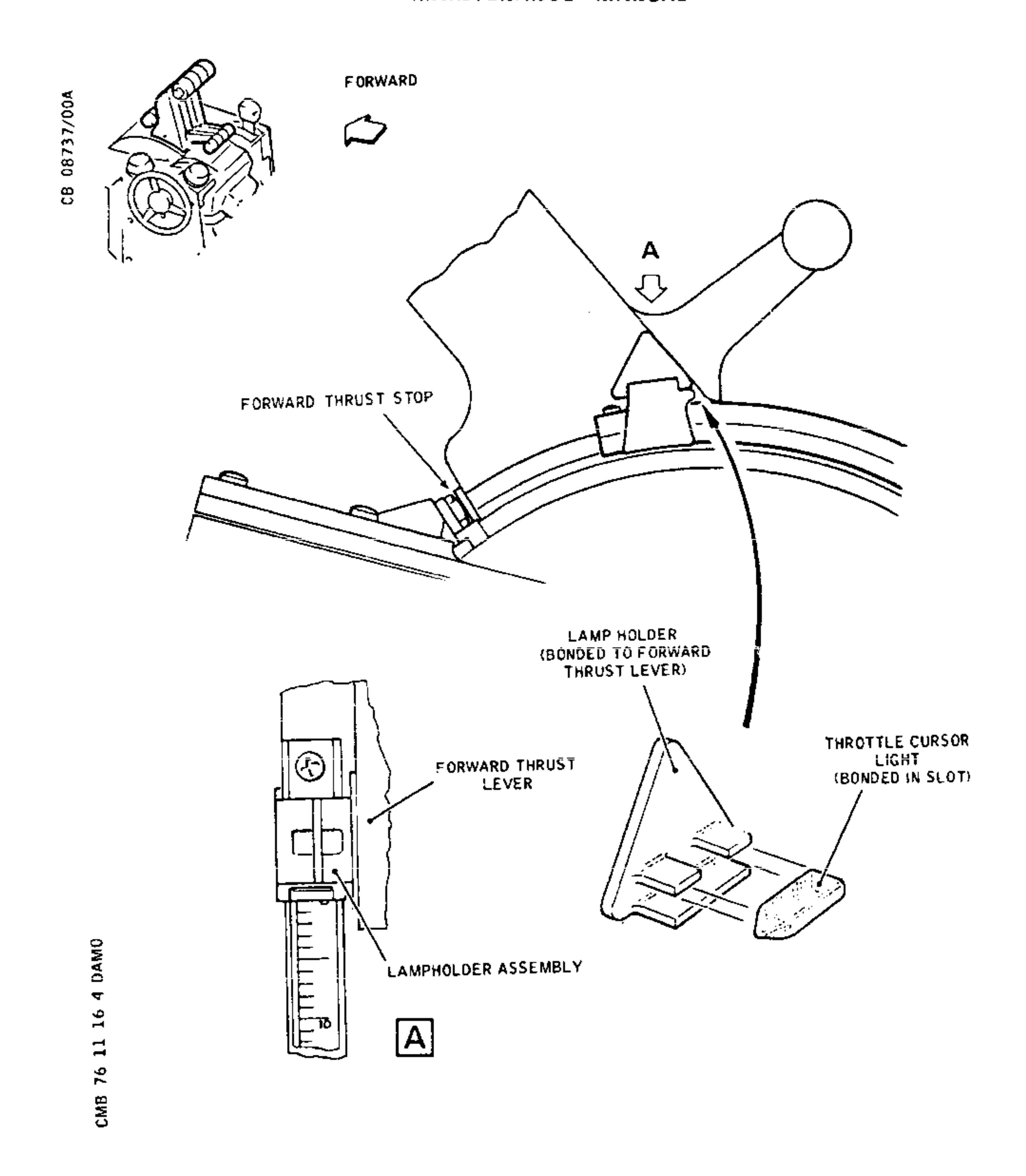
NOTE: Place a protective sheet over the centre console to prevent possible damage and ingress of foreign particles during this operation.

(2) Remove if necessary the old lamp holder assembly from the No.1 forward thrust lever. Wipe away the old adhesive with a dry 'Kimwipe' tissue or use a non-metallic scraper for adhesive removal if necessary.

(3) Bond a throttle cursor light (green) into the lampholder:

(a) Clean the lampholder with a dry 'Kimwipe' tissue.

(b) Bond the throttle cursor light centrally into the slot in the lampholder with RTV731 (Ref. 20-25-12).



R Bonding Lampholder to No.1 Forward Thrust Lever
Figure 404

R NOTE: Ensure that the slot area indicated in the illustration is kept clear of bonding compounds or paint.

R (c) Seal the ends of the slot in the lamp holder flush with adhesive (Ref.20-25-14).

R (4) Paint the lampholder assembly dark grey (Ref. 20-24-36).

R C. Installation

R NOTE: The centre console must be protected against possible spillage of bonding compound.

R (1) In the flight compartment, advance No.1 forward thrust lever to max. rpm.

R (2) Set the adjustable cursor to coincide with '0' on the graduated throttle scale.

R (3) Engage the lampholder with No.1 forward thrust lever and establish a vertical gap of 0.048 in (1.067 mm) between the lampholder and the adjustable cursor body.

R NOTE: A non-metallic packer may be used for this purpose.

R (4) Bond the lampholder to No.1 forward thrust lever (Ref. 20-25-14) in such a manner that the throttle cursor light and scale cursor light are aligned.

R (5) Repeat, if necessary, Operation (1) to (6) for No.4 forward thrust lever.

R D. Conclusion

R (1) Check that the area is clean and remove the protective sheet covering the centre console.

R (2) Remove the safety clips and reset the circuit breakers previously tripped.

R (3) Carry out an Operational test on the throttles (Ref. 76-11-00, Adjustment/Test).

FORWARD AND REVERSE THRUST BAULK SOLENOIDS - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00

1. General

The baulk solenoids, complete with electrical cables (flying leads) are located in the centre console.

2. Baulk Solenoids (Ref. Fig.401 and 402)

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Locking pin (2), droop nose	E925045031
Torque spanner, range 0-80 lbf in (0-0.90 mdaN)	-
Torque screwdriver, range 0-80 lbf in (0-0.90 mdaN)	-
Vidaflex	BA/7857-M017-C
Tape, P.T.F.E.	BAS 8080-29
Non-corrodible steel wire, 0.028 in (0.71mm) dia.	-

B. Prepare to Remove Baulk Solenoids

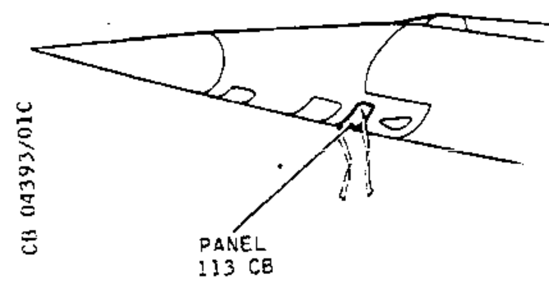
(1) Electrically isolate the relevant services in the centre console by tripping the circuit breakers and securing them with safety clips.

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	AFCS 1 CONT	1-213	1C19	Q14
R	AT 1 CONT	1-213	1C180	Q12

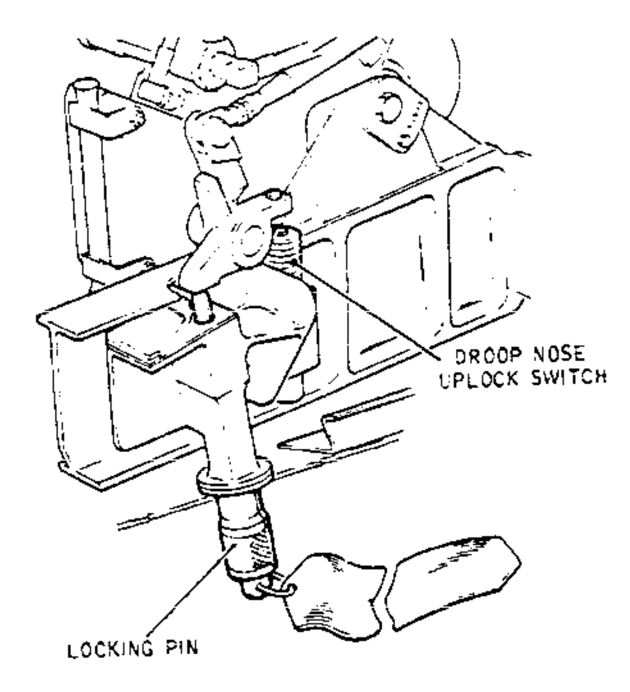
SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
AFCS 2 CONT	5-213	2C19	A12
AT 2 CONT	5-213	2C180	A14
NOSE 7 1/2° CONT	1-213	M12	Q16
VISOR & NOSE CONT	15-215	M11	F 8
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17
CHART STOWAGE LTS SUP	15-216	L237	D12
ENG 1 REHEAT CONT	15-216	1K1542	E 9
ENG 1 REHEAT AMP SUP	14-215	1K1541	C12
ENG 2 REHEAT CONT	15-215	2K1542	D15
ENG 2 REHEAT AMP SUP	13-215	2K1541	B14
ENG 3 REHEAT CONT	15-215	3K1542	D16
ENG 3 REHEAT AMP SUP	13-216	3K1541	B 7
ENG 4 REHEAT CONT	15-216	4K1542	E10
ENG 4 REHEAT AMP SUP	14-216	4K1541	D 7
ENG 1 REV THRUST ASOV CONT	3-213	1K334	G 3
ENG 2 REV THRUST ASOV CONT	1-213	2K334	D 7
ENG 3 REV THRUST ASOV CONT	1-213	3K334	D 8
ENG 4 REV THRUST ASOV CONT	3-213	4K334	G 4
ENG 1 REV THRUST CONT	3-213	1K331	D 1
ENG 2 REV THRUST CONT	1-213	2K331	B 5
ENG 3 REV THRUST CONT	1-213	3K331	B 6
ENG 4 REV THRUST CONT	3-213	4K331	D 2
ENG 1 REV BUCKET POSN IND	5-213	1E121	A 3
ENG 2 REV BUCKET POSN IND	1-213	2E121	B 7
ENG 3 REV BUCKET POSN IND	1-213	3E121	B 8
ENG 4 REV BUCKET POSN IND	5-213	4E121	A 4

(2) If the droop nose is up fit the droop nose locking pins. (Ref. Fig. 401).

(3) Remove the centre console side panels.







Droop Nose Locking Pins.
Figure 401

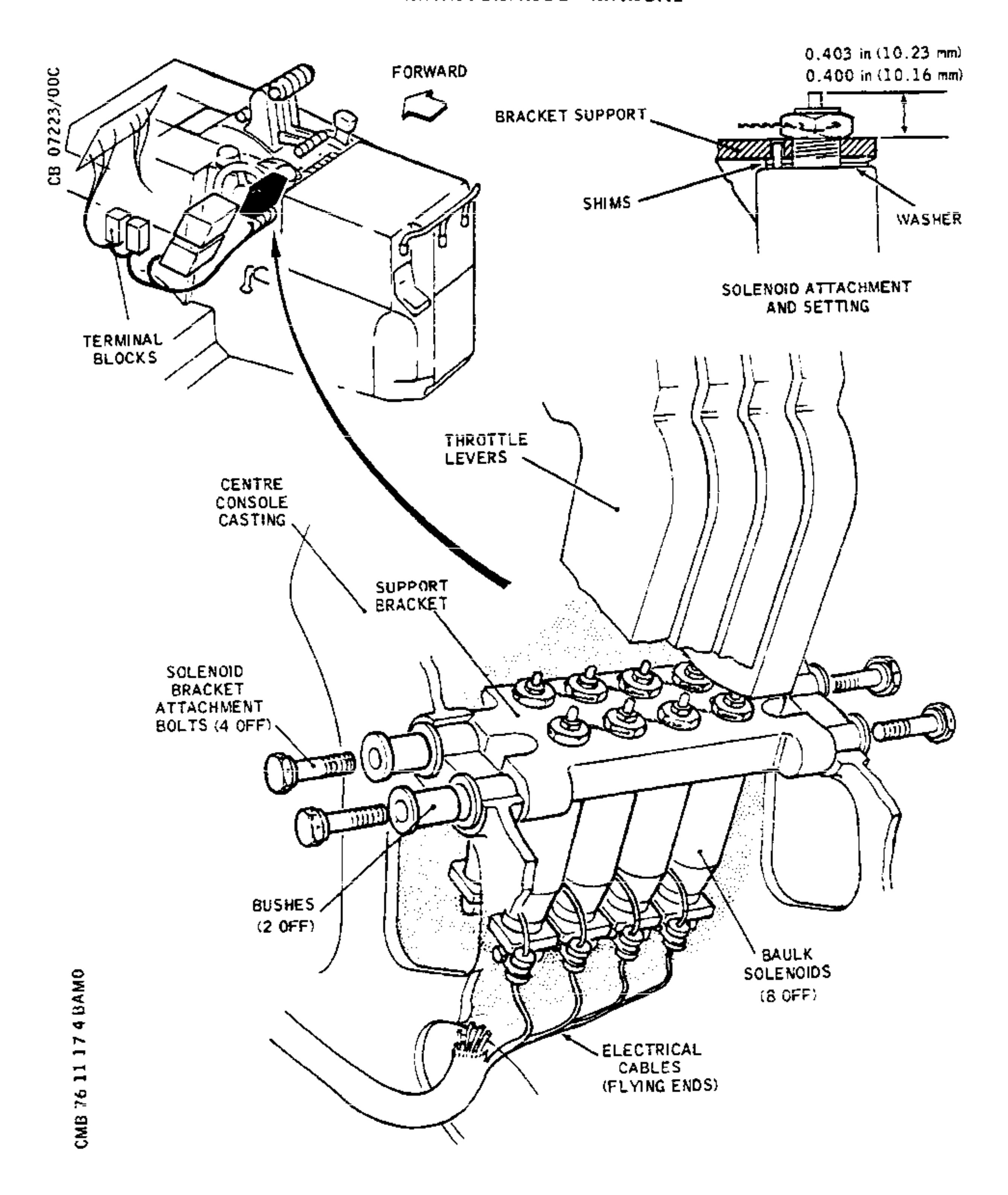
(a) Release the screws securing the forward and aft side panels and remove the forward panels.

(b) Ease the aft panels away from the console structure and disconnect the electrical plugs for the pilots' floor illumination, at the receptacles U2025 on the left-hand panel and U2026 on the right-hand panel.

(c) Remove the left-hand aft panel.

(d) Disengage the droop nose emergency drop control handle from its stowage on the right-hand aft panel by pulling the ring on the pip-pin, taking care not to rotate the handle.

(e) Ease the aft panel away from the console structure and depress the release stud on the shaft end of the droop nose emergency drop control handle. Carefully withdraw



R Baulk Solenoids - Installation.
Figure 402

the handle from its shaft.

(f) Remove the aft panel.

(4) Place the four throttle levers in the idle position.

C. Remove Baulk Solenoids (Ref. Fig. 402):

(1) Release the baulk solenoid loom clipping.

(2) Disconnect the solenoid electrical cables from terminal blocks UM2068,2070,2071 and 2072.

(3) Remove the four bolts securing the baulk solenoid support bracket assembly, withdraw the bushes on the LH side and remove the bracket together with the solenoids and their electrical cables.

(4) Remove the solenoid(s) from the bracket.

(a) Unscrew the solenoid attachment nut.

(b) Withdraw the solenoid.

(c) Remove the washer and shims from the solenoid and retain them.

D. Install Baulk Solenoids (Ref. Fig. 402):

(1) Comply with the electrical safety precautions.

(2) Place the washer and shims in position on the solenoid(s).

(3) Engage the solenoid(s) in the support bracket and adjust the shims to give a plunger protrusion of between 0.400 and 0.403 in (10.16 and 10.24mm).

(4) Fit the attachment nut to the solenoid and torque load the nut to between 65 and 75 lbf in (0.73-0.85 mdaN).

(5) Lock the solenoid attachment nut(s) with non-corrodible steel wire, 0.028 in (0.71mm) dia, in groups of four.

(6) Ensure that the two droop nose locking pins are engaged in the droop nose uplocks.

(7) Ensure that the baulk solenoid area within the console is clean.

(8) Place the throttle levers in the 'idle' position.

(9) Position the solenoid support bracket in the console frame, insert the two flanged bushes in the holes on the left-hand side of the frame and fit the support bracket attachment bolts. Torque tighten the bolts to between 50 and 60 lbf in (0.56 and 0.67 mdaN).

(10) Lock the support bracket bolts with non-corrodible steel wire, 0.028 in (0.71mm) dia, in pairs.

(11) Fit the cable clips to the loom and the console structure.

(12) Connect the solenoid cables to terminal blocks UM2068,2070,2071 and 2072 in accordance with the cable identification sleeves and the Wiring Diagram Manual.

(13) Function test the baulk solenoids (Ref. 76-11-17, Adjustment/Test).

E. Conclusion.

(1) Install the centre forward and aft side panels.

(a) Ensure that the console area is clean.

(b) Attach the left-hand and right-hand forward panels and torque tighten the attachment screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(c) Loosely position the left-hand aft panel and connect the floor illumination electrical plug to receptacle U2025 on the panel.

(d) Torque tighten the panel attachment screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(e) Loosely position the right-hand aft console panel and connect the floor illumination plug to receptacle U2026 on the panel.

(f) Attach the droop nose emergency drop control handle by depressing the release stud on

the handle and sliding the handle onto its shaft until the release stud mechanism engages with its housing in the shaft.

(g) Torque tighten the panel attachment screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(h) Stow the nose emergency drop control handle by pressing the pip-pin into its housing on the side panel.

(2) Remove the droop nose locking pins from the droop nose uplocks.

(3) Remove the safety clips and reset the circuit breakers not reset for the Adjustment/Test operation.

(4) Function test the pilots' floor illumination circuit.

FORWARD AND REVERSE THRUST BAULK SOLENOIDS - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00

1. General

The forward and reverse baulk solenoids are located inside the centre console casting and are adjusted by shims during installation (Ref. 76-11-17, Removal/Installation).

Test instructions are given for No. 1 throttle channel and should be repeated on the other throttle channels. During the test the aircraft weight is to be on the landing gear. For full details of the tests and adjustments on the thrust reverse and wind down system refer to 78-00-00, Adjustment/ Test.

2. Baulk Solenoids - Operational Test.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare

(1) Trip the appropriate circuit breakers and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1 REV THRUST ASOV CONT	3-213	1K334	G 3
ENG 2 REV THRUST ASOV CONT	1-213	2K334	D 7
ENG 3 REV THRUST ASOV CONT	1-213	3K334	D 8

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 4 REV THRUST ASOV CONT	3-213	4K334	G 4

(2) Ensure that a ground air supply is not connected to either of the exhaust system test connections located on each side of the rear engine bay centre wall. Also place a warning placard near the test connections to the effect that an air supply must not be connected.

(3) Ensure that circuit breaker 1E121 on panel 5-213 is made.

(4) Make available electrical ground power (Ref. 24-41-00).

(5) Ensure that the aircraft weight is on the landing gear.

C. Test (Ref. Fig. 501)

(1) Check the reverse baulk:

(a) Ensure that the throttle (forward thrust) lever is fully rearward at idle.

(b) Move the reverse thrust lever aginst the reverse baulk.

(c) Set the wind down test switch to position A.

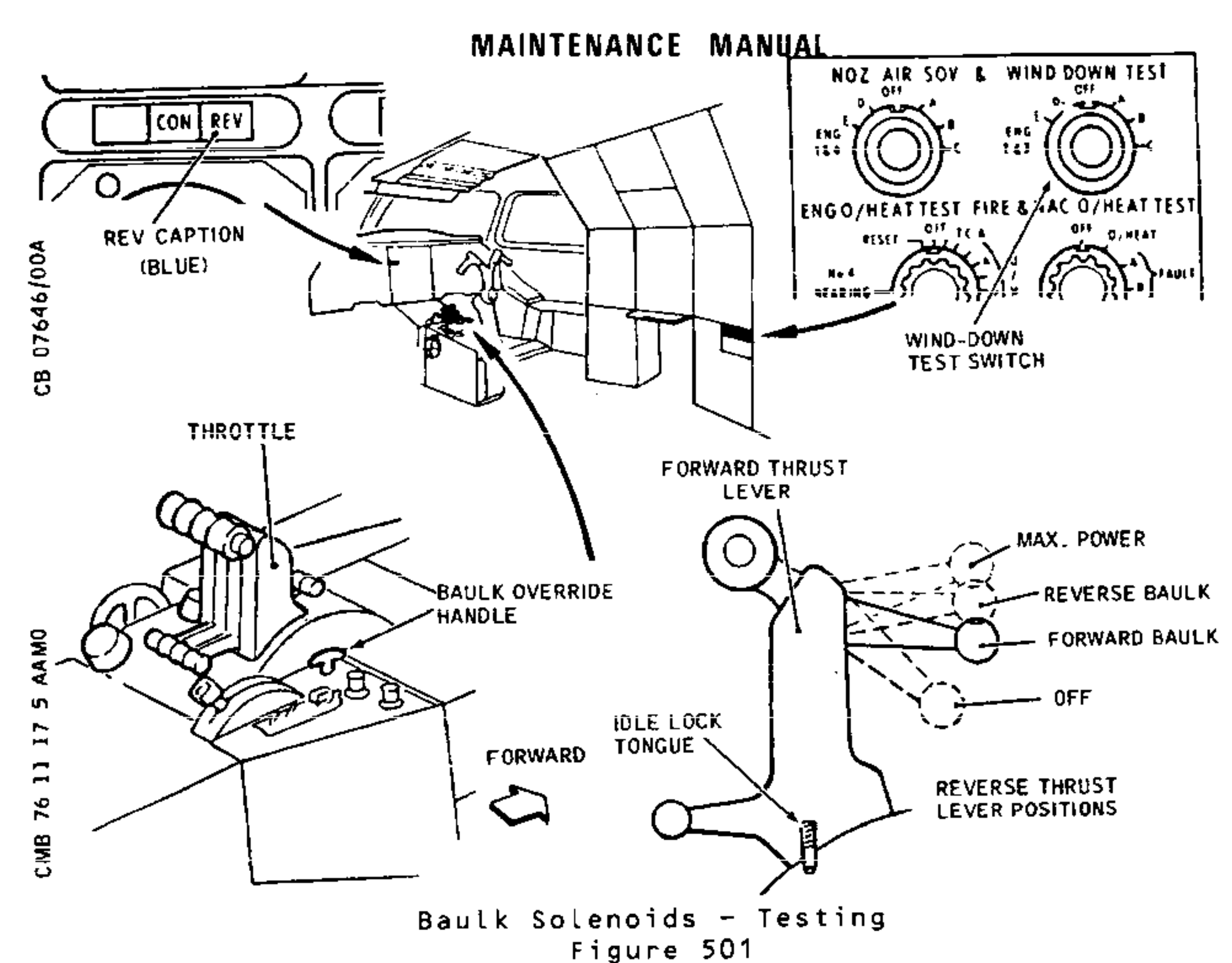
NOTE: The blue REV caption of the power management lights will illuminate, steady.

(d) Move the reverse thrust lever to maximum power; this confirms that the reverse baulk has withdrawn.

NOTE: If the reverse thrust lever is still baulked, refer to 71-00-51, Trouble shooting.

(2) Check the forward baulk:

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Baulk Solenoids - Testing
Figure 501

(a) Move the reverse thrust lever against the forward baulk.

(b) Set the wind down test switch to position C.

NOTE: The blue REV caption of the power management lights will illuminate-flashing.

(c) Move the reverse thrust lever to off; this confirms that the forward baulk has withdrawn.

NOTE: If the reverse thrust lever is still baulked, use the FWD BAULK O/RIDE to return the reverse thrust lever to off, and refer to 71-00-51, Trouble shooting.

(d) Select "OFF" on the wind down test switch.

D.

(1) If not required for other servicing, disconnect and remove electrical ground power (Ref. 24-41-00).

(2) Remove the warning placard from the test connections.

(3) Remove the safety clips and set the circuit breakers previously tripped.

THROTTLE TRANSMITTER RACKING - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

The throttle transmitter racking is located inside the centre console at floor level. Detailed in this topic are the procedures for the Removal/Installation of the complete transmitter racking, and for the Removal/Installation of the gearbox and lever assembly only.

2. Transmitter Racking

A. Equipment and Materials

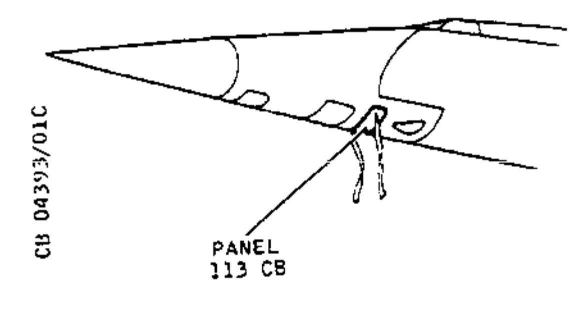
DESCRIPTION	PART NO.
Optical measuring tool	QVA-A01
Gauge position	QC6-A01
Circuit breaker safety clips	-
Hexagonal key 0.12 in (3.05 mm) across the flats	-
Torque spanners range: 0-120 lbf in (0-1.34 mdaN)	-
Screwdriver, torque limiting 0-80 lbf in (0-0.89 mdaN)	
Cable tie	BAS 7183
Corrosion resistant locking wire 0.028 in (0.71 mm) dia	-
Locking pins (droop nose)	E925045031
Vidaflex	BAS 7857.M017.C
Braided cable sleeving	BAS 8699

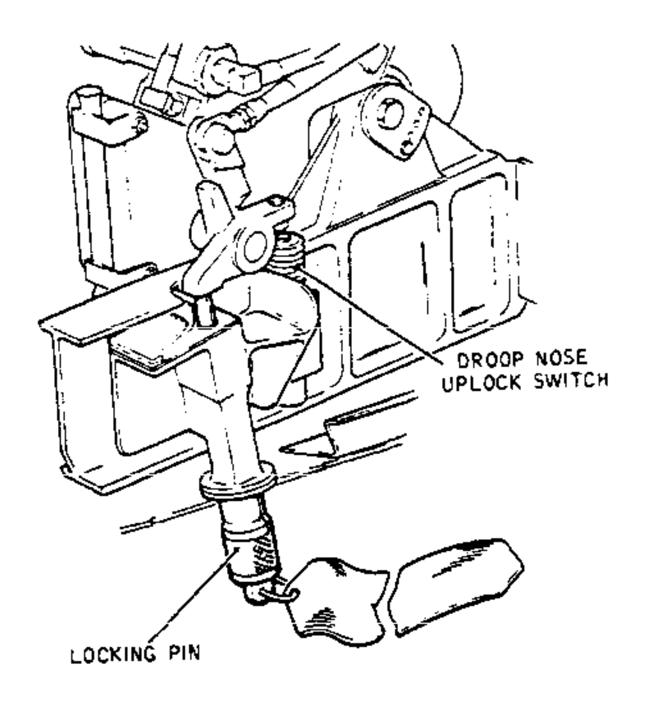
B. Prepare to Remove Transmitter Racking (Ref. Fig.401 and 402)

(1) Electrically isolate services in the centre console by tripping the circuit breakers and securing them with safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALT THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C12
PP MGT LTS SUP	5-213	1E461	D 1
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALT THROT CONT	15-215	2K4	F15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	13-215	2K1541	B14
PP MGT LTS SUP	1-213	2E461	E 3
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALT THROT CONT	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6
REHEAT CONT	15-215	3K1542	D16
REHEAT AMP SUP	13-216	3K1541	B 7
PP MGT LTS SUP	1-213	3E461	E 4
ENG 4			
MAIN THROT CONT	3-213	4K3	A 2
ALT THROT CONT	15-216	4K4	F11
REV THRUST CONT	3-213	4K331	D 2
REHEAT CONT	15-216	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7
PP MGT LTS SUP	5-213	4E461	D 2
AT SYS 1 SUP	13-215	1C179	C 6
AT SYNCHRO SYS 1 SUP	13-215	1C181	D 5
AT 1 CONT	1-213	1C180	Q12
AFCS 1 CONT	1-213	1C19	Q14
AT SYS 2 SUP	13-216	2C179	D16

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
AT SYNCHRO SYS 2 SUP	13-216	2C181	B17
AT 2 CONT	5-213	2C180	A14
AFCS 2 CONT	5-213	2C19	A12
CHART STOWAGE LTS SUP	15-216	L237	D12
NOSE 7 1/2° CONT	1-213	M12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17





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Droop Nose Locking Pins
Figure 401

(2) Remove the centre console aft left-hand side panel:

(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilots' floor illumination at the receptacle identified

U2026 on the panel.

(c) Lift the panel spigots clear of the floor; remove the panel.

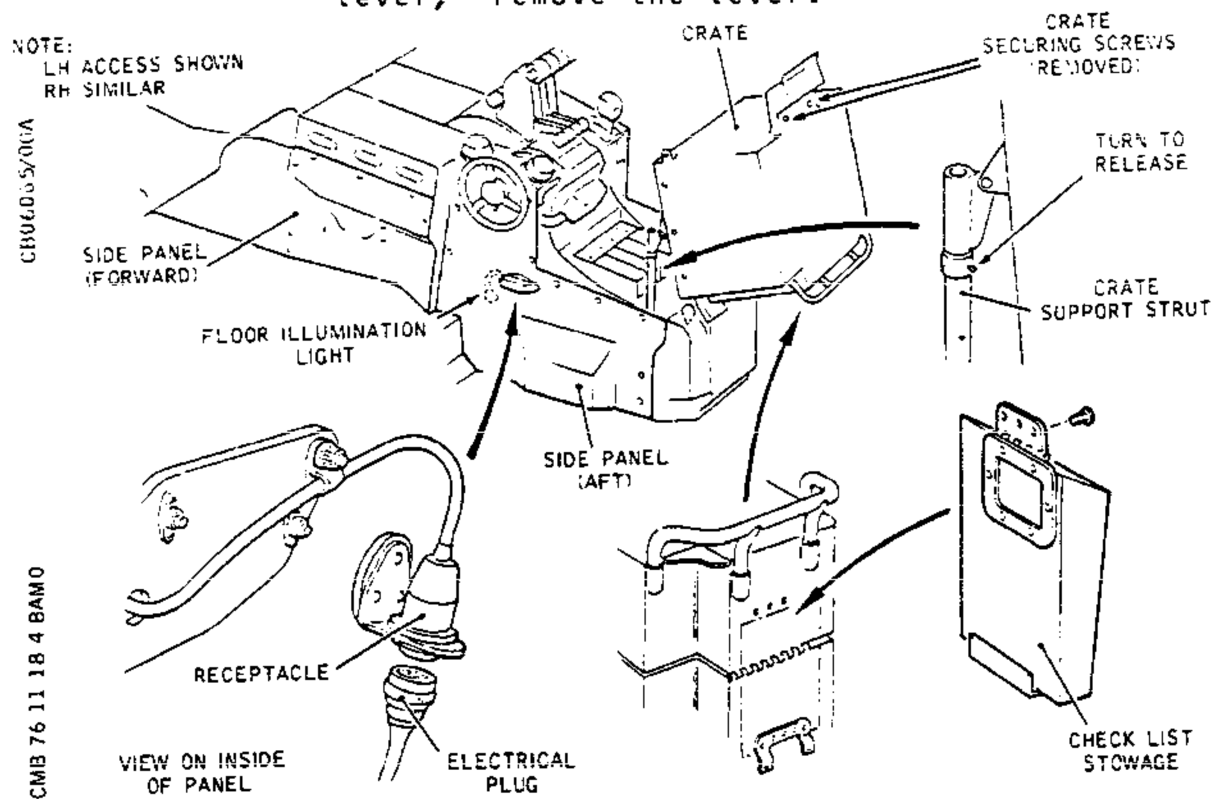
(3) Remove the droop nose emergency lever (Ref. Fig. 401).

NOTE: This can be done with the nose either up or down.

(a) If the nose is up, fit locking pins (2) in the droop nose mechanism.

(b) Remove the quick-release pin at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the left-hand side and depress the spring-loaded pin on the forward end of the droop nose emergency lever; remove the lever.



Centre Console - Access
Figure 402

(4) Remove the centre console aft right-hand side panel in a manner similar to that described for the left-hand; the electrical plug identification is U2025.

(5) Remove the centre console forward side panels:

NOTE: To improve access to the centre console it may be necessary to remove the co-pilot's seat (Ref. 25-11-21, Removal/Installation).

(6) Remove the screws securing the check list stowage, remove the stowage.

(7) Remove the screws securing the crate; hinge back the crate.

C. Remove Transmitter Racking (Ref. Fig. 403)

(1) Unscrew the knurled nuts to extract the four throttle transmitters.

(2) Remove the bolts securing the reverse thrust switch pack mounting brackets. Move the mounting bracket and switch pack rearwards. Do not disturb the electrical connections.

(3) Remove the auto-throttle actuator (Ref. 22-31-61, Removal/Installation).

(4) Disconnect the four quick-release couplings on the rod linkages to the friction device.

(5) Disconnect the throttle connecting rods at the quick-release couplings.

(6) Remove the screws securing the floor plate, below the auto-throttle actuator; remove the plate.

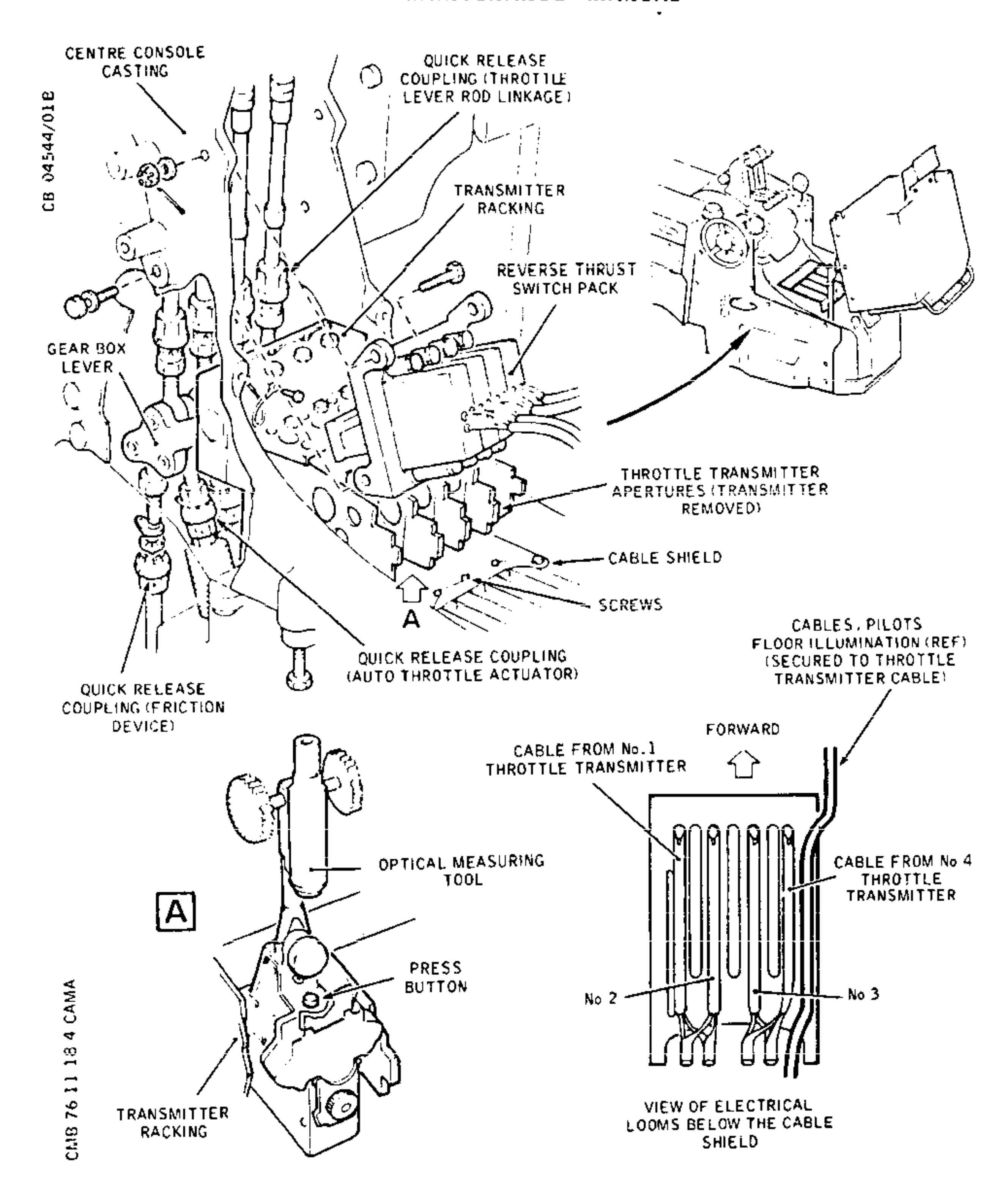
(7) Disconnect the electrical plugs and cables:

(a) Disconnect the four racking electrical connections at the plug breaks identified U1214 (WHITE), U1215 (YELLOW), U1216 (RED) and U1217 (BLUE).

(b) Remove the pins from the cable carrier.

(c) Remove the loom clipping and manoeuvre the electrical cables through to the racking.

(8) Remove the screws securing the racking to the centre



- Throttle Transmitter Racking, Removal
(Sheet 1 of 2)
Figure 403

R

CB 06622/00B

A

THROTTLE TRANSMITTER RACKING

CABLE SHIELD SCREW

REAR OF CENTRE CONSOLE

CABLE CARRIER PINS

GEARBOX LEVER

CABLE No. 4 THROTTLE TRANSMITTER

AUTO THROTTLE ACTUATOR

CABLE CARRIER

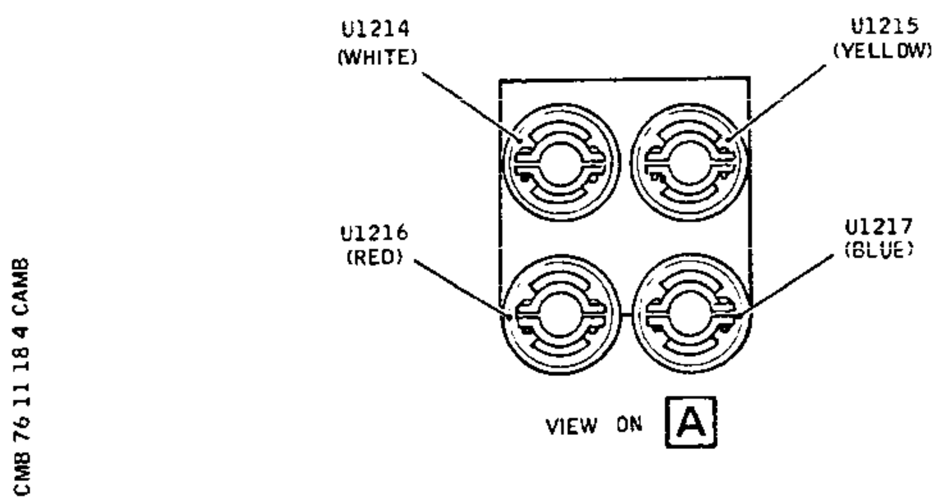
FLOOR PLATE

ELECTRICAL CABLES

A

SCREW (SECURING RACKING TO CENTRE CONSOLE CASTING)

ELECTRICAL PLUG CONNECTIONS



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- Throttle Transmitter Racking, Removal
(Sheet 2 of 2)
Figure 403

R

console casting.

(9) Remove the screw securing the bonding lead to the casting.

(10) Remove the screws securing the cable shield between the racking and the casting; withdraw the racking and the cable shield complete, taking care not to damage the electrical cables.

D. Prepare to Install Transmitter Racking (Ref. Fig.401 and 402)

(1) Comply with the electrical safety precautions.

(2) Comply with the droop nose safety precautions.

(3) Ensure that the area inside the centre console casting is clean.

E. Install Transmitter Racking (Ref. Fig. 403)

NOTE: All wire locking to 20-21-13.

NOTE: 1. Ensure that electrical connectors are clean and undamaged. Make electrical connections in accordance with the cable identification and the applicable wiring diagram.

2. Where one or more cable routes run together, or where a loom may contact a metal surface, segregate and sheath each cable route with Vidaflex.

(1) Install the cable shield:

(a) With the racking and cable shield loosely in position, arrange the electrical looms to run fore and aft between the cable shield and the casting. Check that each loom is covered with Vidaflex terminating in a neoprene sheath where it runs below the cable shield. Secure the cable shield in position with the screws; ensure that the cables are not trapped. Lock the screws with a single strand of locking wire from the two end screws.

(b) Connect the electrical leads from the racking to the four receptacles, (Ref. Detail A), identified U1214 (WHITE), U1215 (YELLOW), U1216 (RED), U1217 (BLUE).

(c) Check that the looms are sleeved (Ref. Wiring Diagram Manual 20-41-18).

(d) Secure the cables as necessary with cable ties.

(e) Ensure that the looms lie neatly in the loom carrier.

NOTE: The looms passing through the loom carrier must have additional sleeving (Ref. Wiring Diagram Manual 20-41-18).

(f) Ensure that the pin shank is covered with a shrink sleeve to Wiring Diagram Manual 20-41-18, replace the pins (2) and secure each with a washer and split pin.

(g) Replace the floor plate and secure with the screws.

(2) Locate the racking on the dowels in the casting and and secure it with bolts. Torque load the bolts to between 60 and 70 lbf in (0.67 and 0.78 mdaN) and wirelock in three pairs.

(3) Connect the bonding lead from the racking to the casting and secure it with a screw and washer, tighten and lock the screw to the nearest nut on the racking.

(4) Connect the four throttle connecting rods to the gearbox levers on the racking:

(a) Assemble the locknut and lock washers onto the eye-end of each gearbox lever.

(b) Ensure that the mating surfaces of the quick-release coupling are clean.

(c) Holding the eye-end firmly engage and tighten the quick-release nut until the rod ends contact.

CAUTION: WHEN TIGHTENING THE QUICK-RELEASE NUT ENSURE THAT THE LOAD IS NOT REACTED AGAINST THE BALL JOINT.

(d) Hold the eye-end securely and torque load the nut to between 30 and 36 lbf in (0.34 and 0.4 mdaN).

(e) Arrange the locking washers in the slots of the quick-release nut.

WARNING: THE LUGS OF THE LOCKWASHERS MUST FACE FORWARD.

(f) With a spanner on the quick-release nut tighten the locknut and torque load to between 10 and 15 lbf in (0.11 and 0.17 mdaN) and wirelock.

(5) Check the setting of each throttle connecting rod:

(a) Check the measuring tool with the position gauge and calibrate as necessary.

(b) Insert the measuring tool into No.1 throttle transmitter racking and tighten the knurled nut.

(c) Hold No.1 throttle lever lightly against its idle stop. Check that the scale reading, observed through the telescope eyepiece, is between 35 deg 50 min and 36 deg 10 min. If the reading is outside these limits, adjust No.1 throttle lever rod linkage.

NOTE: If necessary, the scale can be illuminated by pressing the button on the tool.

(6) Adjust the throttle lever rod linkage.

WARNING: THE LUGS ON THE LOCKWASHERS MUST FACE FORWARD.

(a) Slacken both locknuts on the rod.

NOTE: The top nut is LH thread.

(b) Slacken the knurled nut back just sufficient to give rotational freedom to the rod.

(c) Turn the rod clockwise or counterclockwise to adjust the rod length, until a reading of between 35 deg 50 min and 36 deg 10 min is obtained on the test equipment.

(d) At the top of the rod, arrange the locking washers in the slots of the rod and, with the rod held firmly, tighten and torque load the locknut to between 30 and 36 lbf in (0.34 and 0.40 mdaN).

(e) Check that the rod end blocks the inspection hole in the rod.

CAUTION: WHEN TIGHTENING THE QUICK-RELEASE NUT ENSURE THAT THE LOAD IS NOT REACTED AGAINST THE BALL JOINT.

(f) At the bottom of the rod hold the eye-end firmly and tighten the quick-release nut until the rod ends contact. Torque load it to between 30 and 36 lbf in (0.34 and 0.40 mdaN).

(g) Arrange the locking washers in the slots of the quick-release nut.

(h) With a spanner on the quick-release nut torque tighten the locknut to between 10 and 15 lbf in (0.11 and 0.17 mdaN).

(i) Check that the tolerance of 35 deg 50 min to 36 deg 10 min includes the system backlash by moving the forward thrust lever forward and then back against the idle stop.

(j) Move the forward thrust lever to maximum thrust and hold it lightly against the stop. The reading on the test equipment should be between 0 deg and minus 0 deg 20 min.

(k) Lock the locknuts at both the top and bottom of the rod with locking wire.

(l) Recheck the tolerance at the idle and maximum thrust stops.

(m) Remove the measuring tool.

(n) Repeat this adjustment on each throttle lever rod linkage.

(7) Install and adjust the auto-throttle actuator (Ref. 22-31-61, Removal/Installation).

(8) Connect the four rod linkages to the friction devices:

(a) Assemble the locknut and lockwashers onto the eye-end of each gearbox lever.

(b) Ensure that the mating surfaces of the quick-release coupling are clean.

(c) Holding the eye-end firmly, engage and tighten the quick-release nut until the rod ends

contact; torque load it to between 30 and 36 lbf in (0.34 and 0.40 mdaN).

CAUTION: WHEN TIGHTENING THE QUICK-RELEASE NUT ENSURE THAT THE LOAD IS NOT REACTED AGAINST THE BALL JOINT.

(d) Arrange the locking washers in the slots of the quick-release nut.

WARNING: THE LUGS OF THE LOCKWASHERS MUST FACE FORWARD.

(e) With a spanner on the quick-release nut torque tighten the locknut to between 10 and 15 lbf in (0.11 and 0.17 mdaN); wirelock the locknut.

(9) Engage the mounting bracket for the reverse thrust switch packs with the casting and secure:

(a) Check that the bushes are in place in the casting, in the top two holes, and the bottom right-hand hole.

(b) Secure each side of the mounting bracket at the top with a bolt, washer, and nut. Torque load each bolt to between 50 and 60 lbf in (0.56 and 0.67 mdaN), and lock it with a split pin.

(c) Secure the bottom of the mounting plate with a bolt at each side. Torque load each bolt to between 50 and 60 lbf in (0.56 and 0.67 mdaN) and lock it with wire to the drilling in the casting.

(10) Install the four throttle transmitters (Ref. 76-11-12, Removal/Installation).

F. Conclusion (Ref. Fig.401 and 402)

(1) Check that the area is clean, release the locking struts, and hinge forward the crate. Insert the two securing screws and torque load them to between 70 and 80 lbf in (0.78 and 0.89 mdaN).

(2) Engage the check list stowage with the rear of the crate; fit and tighten the securing screws.

(3) Replace the centre console aft right-hand side panel:

(a) Check the panel seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilot's floor illumination at the receptacle identified U2025 on the panel.

(d) Torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(4) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the quick-release pin.

(5) Secure the centre console aft left-hand side panel in a manner similar to that described for the right-hand panel, the electrical plug is idented U2026.

(6) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf (0.44 and 0.51 mdaN).

(7) If necessary, replace the co-pilot's seat (Ref. 25-11-21, Removal/Installation).

(8) Remove droop nose locking pins (2).

(9) Remove the safety clips and reset the circuit breakers previously tripped.

(10) Carry out the following tests on the throttle system.

(a) Mechanical output test (Ref. 76-11-00, Adjustment/Test).

(b) Function test the reverse thrust switches (Ref. 78-31-81, Adjustment/Test).

(c) Function test the input signals to the throttle amplifiers from the throttle transmitters (Ref. 76-11-00, Adjustment/Test).

(d) Function test the auto-throttle system (Ref. 22-31-61, Adjustment/Test).

3. Gearbox and Lever Assembly

A. Equipment and Materials

DESCRIPTION	PART NO.
Optical measuring tool	QVA-A01
Gauge position	QG6-A01
Circuit breaker safety clips	-
Hexagonal key 0.12 in (3.05 mm) across the flats	-
Torque spanners range: 0-120 lbf in (0-1.34 mdaN)	-
Cable tie	BAS7183
Locking wire stainless steel 0.028 in (0.71 mm) dia	-
Vidaflex	BAS7857 M017.C

B. Prepare to Remove Gearbox and Lever Assembly (Ref. Fig.401 and 402)

(1) Carry out the preparatory procedures in para.2B.

C. Remove the Gearbox and Lever Assembly (Ref. Fig. 404)

(1) Disconnect the four quick-release couplings to the auto-throttle actuator.

(2) Disconnect the four quick-release couplings on the rod linkages to the friction device.

(3) Release the knurled nuts and unscrew to extract the four throttle transmitters (Ref. 76-11-12).

(4) Remove the bolts securing the reverse thrust switch pack mounting bracket. Move the mounting bracket and switch pack rearwards. Do not disturb the electrical connections (Ref. Fig. 403).

(5) Disconnect the four throttle lever rod linkages at the quick-release couplings.

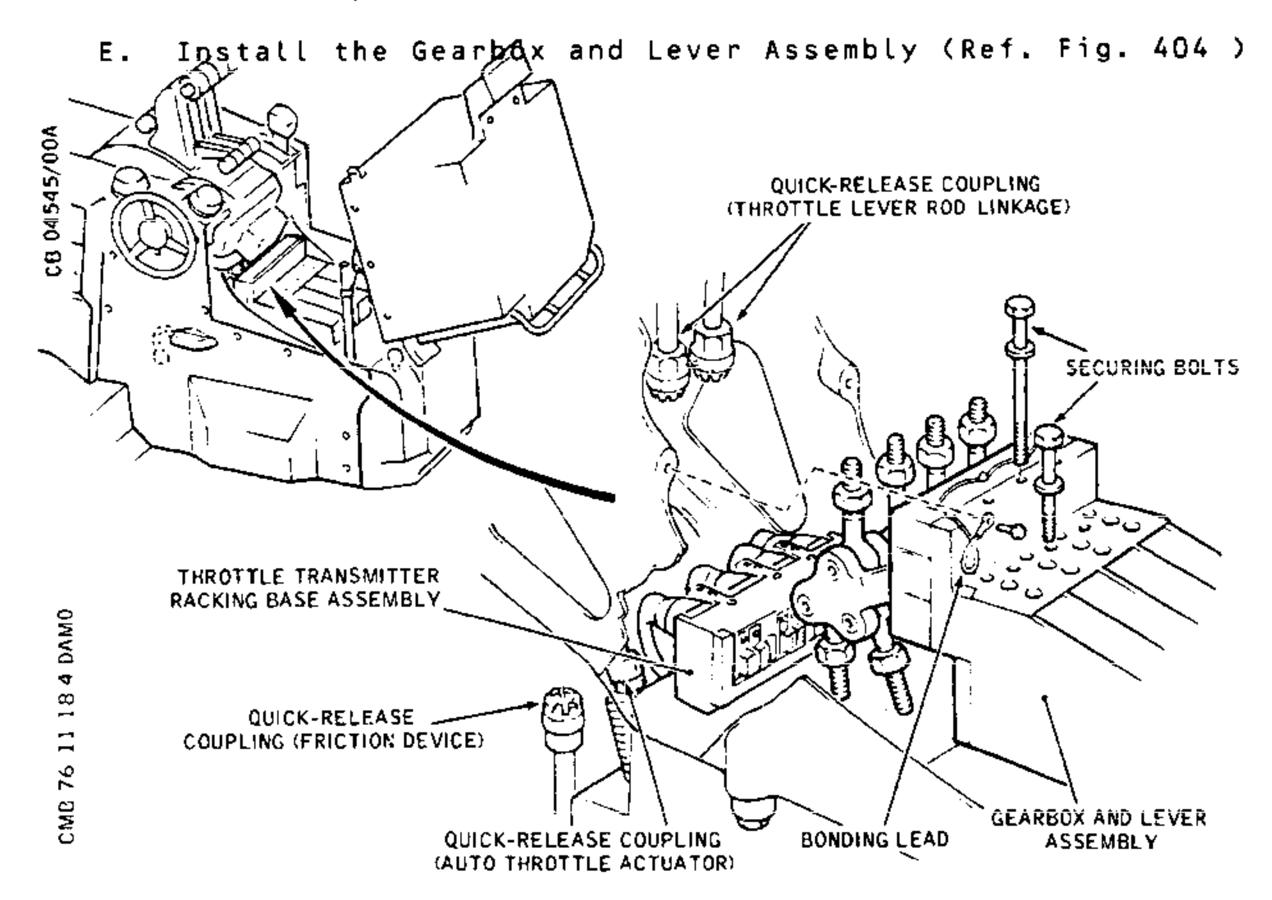
(6) Disconnect the bonding lead from the racking.

(7) Remove the six bolts securing the gearbox and lever assembly to the base of the throttle transmitter racking; remove the gearbox and lever assembly.

D. Prepare to Install the Gearbox and Lever Assembly (Ref. Fig.401 and 402)

(1) Carry out the preparation instructions in para.2D.

E. Install the Gearbox and Lever Assembly (Ref. Fig. 404)



Gearbox and Lever Assembly
Figure 404

NOTE: All wire locking to 20-21-13.

(1) Locate the gearbox and lever assembly on the spigots of the throttle transmitter racking; secure it with the six bolts and washers. Torque load each bolt to between 60-70 lbf in (0.67-0.78 mdaN) and wirelock in two lots of three.

(2) Connect the bonding lead to the gearbox assembly and torque load the bolt to 46 lbf in (0.52 mdaN). Lock

the bolt with locking wire.

(3) Connect the four throttle lever rod linkages to the gearbox levers on the racking:

(a) Assemble the locknut and lockwashers onto the eye-end of each gearbox lever.

(b) Engage the throttle lever rod linkages with the eye-end and screw on the quick-release nut until the rod ends contact. Torque load each quick-release nut to between 30 and 36 lbf in (0.34 and 0.4 mdaN).

CAUTION: HOLD THE EYE-END FIRMLY WHEN TIGHTENING THE NUT TO ENSURE THAT THE LOAD IS NOT REACTED AGAINST THE BALL JOINT.

(c) Hold the quick-release nut and torque load the locknut to between 10 and 15 lbf in (0.113 and 0.17 mdaN); do not lock.

(4) Check the setting of the throttle lever rod linkages:

(a) Insert the tool for measuring rotation of the transmitter drive coupling.

(b) Hold the forward thrust lever lightly against the idle stop and check the reading on the test equipment, it should be between 35 deg 50 min and 36 deg 10 min.

(c) Move the forward thrust lever to maximum thrust and hold it lightly against the stop. The reading on the test equipment should be between 0 deg and minus 0 deg 20 min. If this is not achieved adjust as in para. 2E.

(d) Lock the throttle connecting rod quick-release nuts and locknuts with locking wire.

(e) Remove the test equipment.

(5) Connect the auto-throttle quick-release connections (Ref. 22-31-61).

(6) Connect the rod linkages to the friction device:

(a) Connect the friction device rod linkages in the manner described in para. 2E.

(7) Engage the mounting bracket for the reverse thrust switch packs with the casting and secure, as described in para. 2E.

(8) Install the four throttle transmitters (Ref. 76-11-12, Removal/Installation).

F. Conclusion (Ref. Fig.401 and 402)

(1) Carry out the procedures detailed in para. 2F including the following tests:

Function test Reverse Thrust Switches (Ref. 71-31-81).

Function test throttle transmitter (Ref. 76-11-00, Adjustment/Test).

Function test auto-throttle (Ref. 22-31-61, Adjustment/Test).

ROD LINKAGE - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

There are four of these rods, one in each throttle channel, each of which transmits throttle lever movement to the transmitter racking. They are located inside the centre console at floor level.

This procedure describes the Removal/Installation of No.1 throttle rod linkage; the rods in the other throttle channels are removed in a similar manner.

2. Rod

A. Equipment and Materials

DESCRIPTION	PART NO.
Optical measuring tool	QV6 A01
Gauge, position	QG6 A01
Circuit breaker safety clips	-
Torque spanner range: 0-80 lbf in (0-0.89 mdaN)	-
Screwdriver, torque limiting range 0-80 lbf in (0.0-89 mdaN)	-
Locking wire, corrosion resistant 0.028 in (0.71 mm) dia	-
Locking pins (droop nose)	E925045031

B. Prepare to Remove Rod (Ref. Fig.401 and 402)

NOTE: To improve access to the centre console it may be necessary to remove the co-pilot's seat (Ref. 25-11-21, Removal/Installation).

(1) Trip the appropriate circuit breakers and secure them with safety clips.

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SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No. 1			
ENG 1 MAIN THROT CONT	3-213	1K3	A 1
ENG 1 ALTN THROT CONT	15-216	1K4	E 8
ENG 1 REV THRUST CONT	3-213	1K331	D 1
ENG 1 REHEAT CONT	15-216	1K1542	E 9
ENG 1 REHEAT AMP SUP	14-215	1K1541	C12
ENG 1 PP MTG LTS SUP	5-213	1E461	D 1
Engine No. 2			
ENG 2 MAIN THROT CONT	1-213	2K3	A 3
ENG 2 ALTN THROT CONT	15-215	2K4	F15
ENG 2 REV THRUST CONT	1-213	2K331	B 5
ENG 2 REHEAT CONT	15-215	2K1542	D15
ENG 2 REHEAT AMP SUP	13-215	2K1541	B14
ENG 2 PP MTG LTS SUP	1-213	2E461	E 3
Engine No. 3			
ENG 3 MAIN THROT CONT	1-213	3K3	A 4
ENG 3 ALTN THROT CONT	15-215	3K4	F16
ENG 3 REV THRUST CONT	1-213	3K331	B 6
ENG 3 REHEAT CONT	15-215	3K1542	D16
ENG 3 REHEAT AMP SUP	13-216	3K1541	B 7
ENG 3 PP MTG LTS SUP	1-213	3E461	E 4
Engine No. 4			
ENG 4 MAIN THROT CONT	3-213	4K3	A 2
ENG 4 ALTN THROT CONT	15-216	4K4	F11
ENG 4 REV THRUST CONT	3-213	4K331	D 2
ENG 4 REHEAT CONT	15-216	4K1542	E10
ENG 4 REHEAT AMP SUP	14-216	4K1541	D 7
ENG 4 PP MTG LTS SUP	5-213	4E461	D 2
Auto flight			
AT SYS 1 SUP	13-215	1C179	C 6
AT SYNCHRO SYS 1 SUP	13-215	1C181	D 5
AT 1 CONT	1-213	1C180	Q12
AFCS 1 CONT	1-213	1C19	Q14
AT SYS 2 SUP	13-216	2C179	D16
AT SYNCHRO SYS 2 SUP	13-216	2C181	B17
AT 2 CONT	5-213	2C180	A14
AFCS 1 CONT	5-213	2C19	A12
CHART STOWAGE LTS SUP	15-216	L237	D12

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
NOSE 7 1/2 CONT	1-213	M12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17

(2) Remove the centre console aft left-hand side panel:

(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilot's floor illumination at the receptacle identified U2026 on the panel.

(c) Remove the panel.

(3) Remove the droop nose emergency lever (Ref. Fig. 401)

NOTE: This can be done with the nose either up or down.

(a) If the nose is up, fit locking pins (2) in the droop nose mechanism.

(b) Remove the quick-release pin at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the left-hand side and depress the spring-loaded pin on the forward end of the droop nose emergency lever; remove the lever.

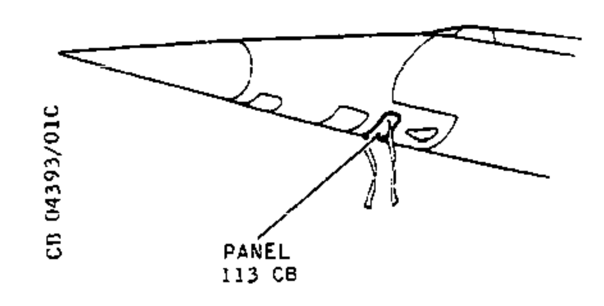
(4) Remove the centre console aft right=hand side panel in a manner similar to that described for the left-hand; the electrical plug identification is U2025.

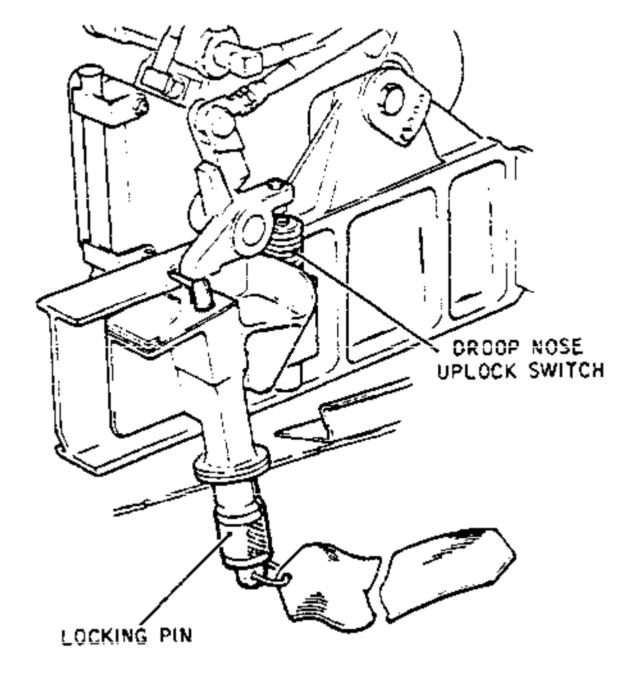
(5) Remove the centre console forward side panels.

(6) Remove the screws securing the check list stowage; remove the stowage.

(7) Remove the screws securing the crate; hinge back the crate.

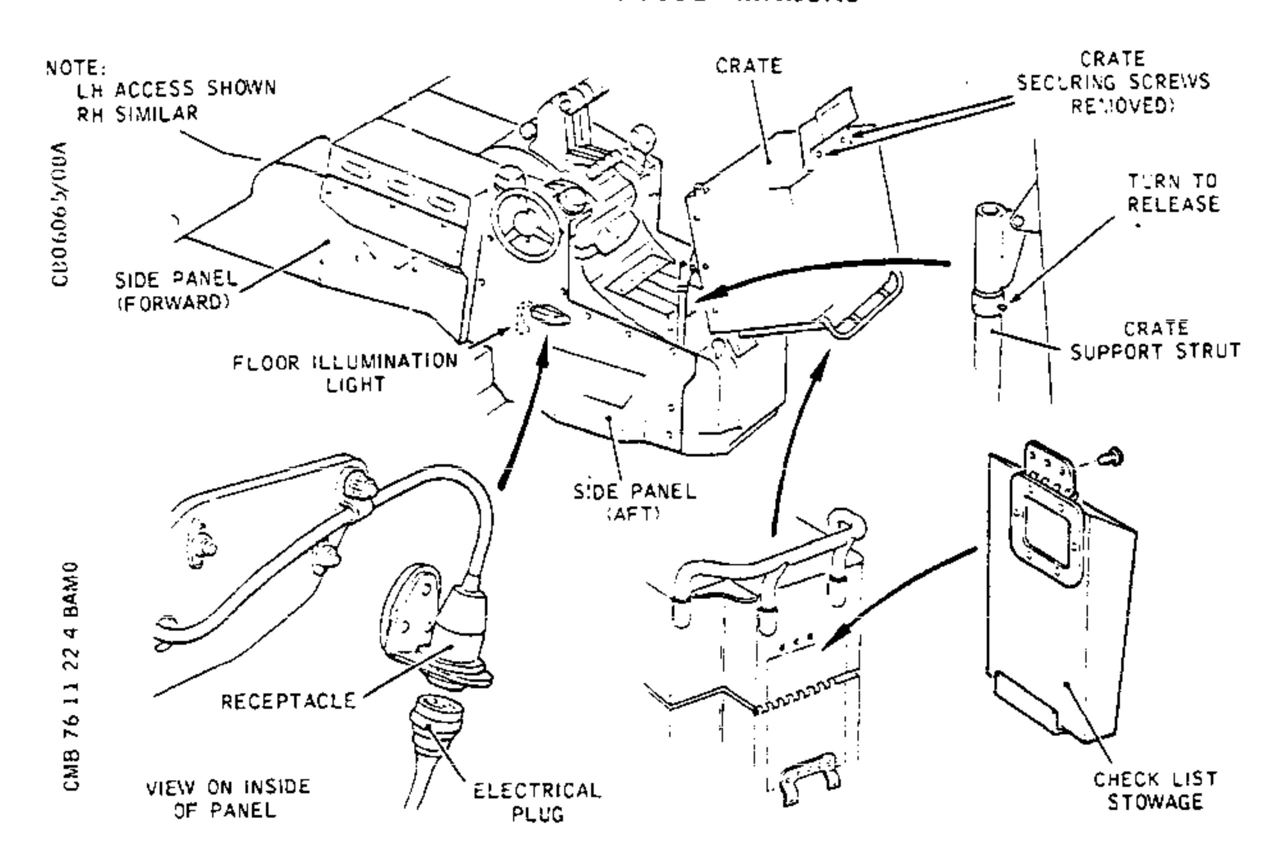
C. Remove Rod (Ref. Fig. 403)





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R - Droop Nose Locking Pins
Figure 401



Centre Console - Access
Figure 402

(1) Unscrew the knurled nuts and extract the throttle transmitter (Ref. 76-11-12, Removal/Installation).

(2) Remove the bolts securing the reverse thrust switch pack mounting bracket. Move the mounting bracket and switch pack rearwards, to the full extent of the electrical leads, and lay the switch pack face downwards. Do not disturb the electrical connections.

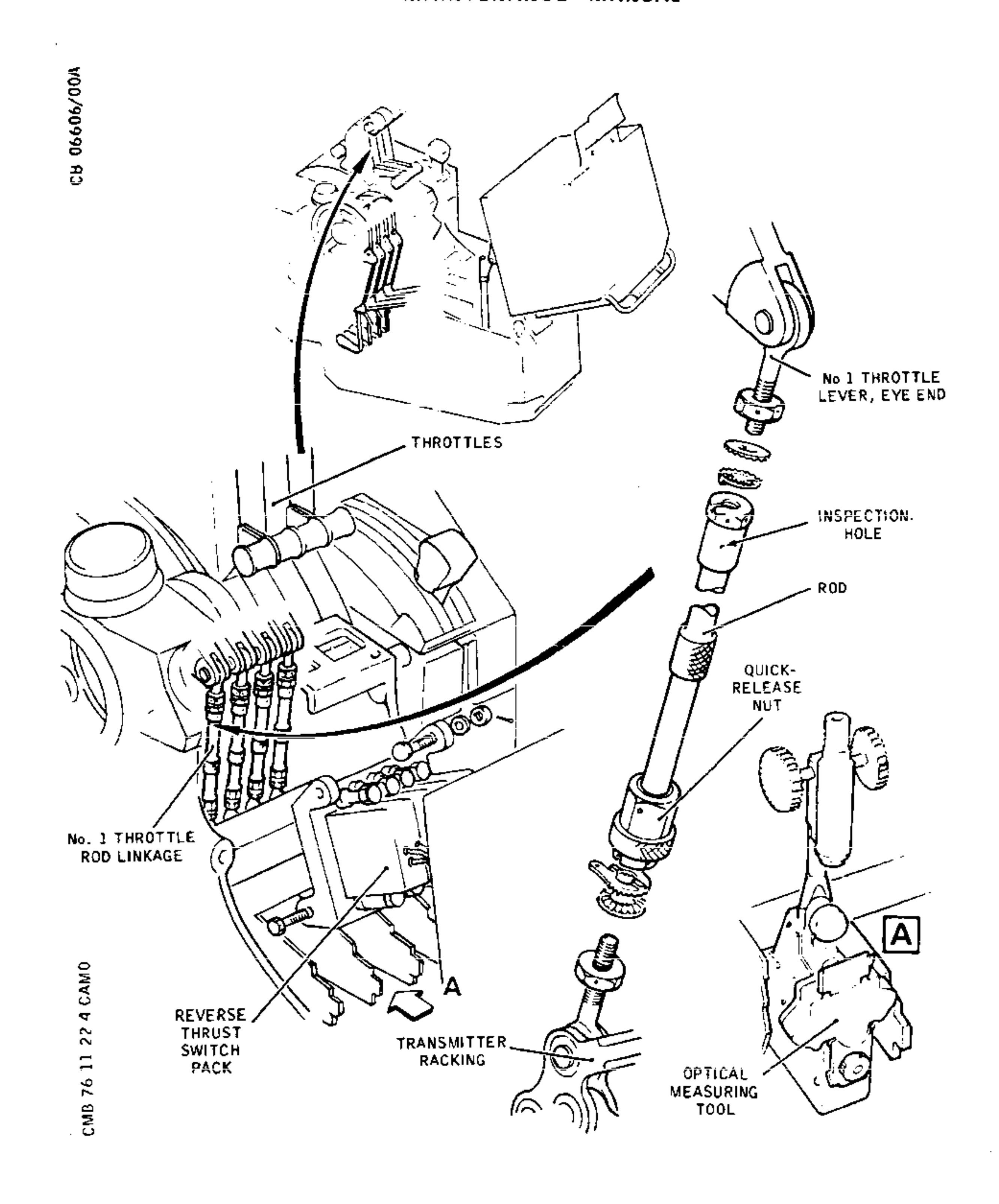
(3) Disconnect the rod at the quick-release coupling:

(a) Remove the locking wire securing the locknut at the quick-release coupling.

(b) Slacken the locknut.

(c) Unscrew the quick-release nut until the connection is broken.

(4) Remove the wire, slacken the locknut, and unscrew the rod from the eye-end of the throttle lever; count the number of turns. Retain the lockwashers.



Rod Linkage - Installation
Figure 403

R

NOTE: The eye-end has a left hand thread.

D. Prepare to Install Rod (Ref. Fig.401 and 402)

(1) Comply with the electrical safety precautions.

(2) Comply with the droop nose safety precautions.

(3) Ensure that the area inside the centre console casting is clean.

E. Install Rod (Ref. Fig. 403)

NOTE: All wire locking to 20-21-13.

(1) Connect the rod:

(a) Install the two lockwashers and screw the rod onto the eye-end of the throttle lever, with the previously noted number of turns. Do not lock.

(b) With a locknut and two lockwashers loosely assembled on the transmitter eye-end, engage the quick-release nut and screw on until the rod bottoms. Do not lock.

CAUTION: WHEN TIGHTENING THE QUICK-RELEASE NUT ENSURE THAT THE LOAD IS NOT REACTED AGAINST THE BALL JOINT.

(2) Check the setting of the rod:

(a) Insert the optical measuring tool for measuring rotation of the transmitter drive coupling (Ref. 76-11-00, Adjustment/Test).

(b) Hold the No.1 throttle lever lightly against the idle stop, and check the reading on the tool, it should be between 36 deg and 36 deg 20 min. Where this reading is not achieved adjust the rod.

(3) Adjust the rod:

(a) Slacken both locknuts and the quick-release nut.

(b) Turn the rod clockwise or counter clockwise to adjust the rod length.

(c) Hold the eye-end firmly and tighten the quick-

release nut until the rod-ends contact.

(4) Repeat the check using the optical measuring tool.

(5) Check that the tolerance of 36 deg to 36 deg 20 min includes the system backlash by moving the throttle lever forward and then back against the idle stop.

(6) Lock the rod:

(a) At the top of the rod, arrange the locking washers in the slots of the rod and, with the rod held firmly, tighten and torque load the locknut to between 30 and 36 lbf in (0.34 and 0.40 mdaN).

(b) At the bottom of the rod hold the eye-end firmly and tighten the quick-release nut until the rod ends contact. Torque load it to between 30 and 36 lbf in (0.34 and 0.40 mdaN).

(c) Arrange the locking washers in the slots of the quick-release nut.

<u>WARNING:</u> THE LUG ON THE LOCKWASHER MUST FACE FORWARD.

(d) With a spanner on the quick-release nut torque tighten the locknut to between 10 and 15 lbf in (0.11 and 0.17 mdaN).

(e) Check that the throttle lever eye-end blocks the inspection hole in the rod.

(f) Lock the quick-release nut and the locknuts at both the top and bottom of the rod with wire.

(7) Move the throttle lever fully forward in the gate and hold it lightly against the stop. The reading on the tool should be between 0 deg and minus 0 deg 20 min.

(8) Repeat the checks on the rod setting using the optical measuring tool.

(9) Check the setting of the forward thrust switch pack (Ref. 76-15-12).

(10) Engage the mounting bracket for the reverse thrust switch packs with the casting and secure:

(a) Check that the bushes are in place in the casting in the top two holes and the bottom right-hand hole.

(b) Secure each side of the mounting bracket at the top with a bolt, washer, and nut. Torque load each bolt to between 50 and 60 lbf in (0.56 and 0.67 mdaN) and lock it with a split pin.

(c) Secure the bottom of the mounting plate with a bolt at each side. Torque load each bolt to between 50 and 60 lbf in (0.56 and 0.67 mdaN) and lock it with wire to the drilling in the casting.

(11) Carry out a functional test of the reverse thrust switches (Ref. 78-31-81 Adjustment/Test)

(12) Remove the optical measuring tool.

(13) Install the four throttle transmitters (Ref. 76-11-12, Removal/Installation).

F. Conclusion

(1) Check that the area is clean, release the locking struts, and hinge forward the crate. Insert the two securing screws and torque load them to between 70 and 80 lbf in (0.78 and 0.89 mdaN).

(2) Engage the check list stowage with the rear of the crate, fit and tighten the securing screws.

(3) Replace the centre console aft right-hand side panel:

(a) Check the panel seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilot's floor illumination at the receptacle identified U2025 on the panel.

(d) Torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(4) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the quick-release pin.

(5) Secure the centre console aft left-hand side panel

in a manner similar to that described for the right-hand panel. The electrical plug is identified U2026.

(6) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(7) If necessary, replace the co-pilot's seat (Ref. 25-11-21, Removal/Installation).

(8) Remove the locking pins (2) from the droop nose.

(9) Remove the safety clips and reset the circuit breakers previously tripped.

(10) Carry out a functional test on the throttle lever mechanical output (Ref. 76-11-16, Adjustment/ Test).

ROD LINKAGE - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00

1. General

A rod linkage, located in the pilots' centre console at floor level, connects the friction device to the transmitter racking in each throttle channel.

This procedure describes the Removal/Installation of No. 1 friction device rod linkage; the rods in the other throttle channels are removed in a similar manner.

2. Rod

A. Equipment and Materials

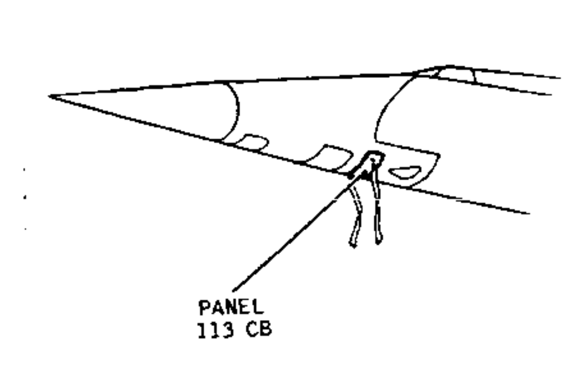
	DESCRIPTION	PART NO.
R	Optical measuring tool	QV6 A01
R	Gauge, positions	QG6 A01
R	Circuit breaker safety clips	-
R R	Torque spanners range: 0-80 lbf in (0-0.89 mdaN)	- -
R R	Locking wire stainless steel 0.028 in (0.71 mm) dia	- -
R R R	Screwdriver, torque limiting 0-80 lbf in (0-0.89 mdaN)	 -

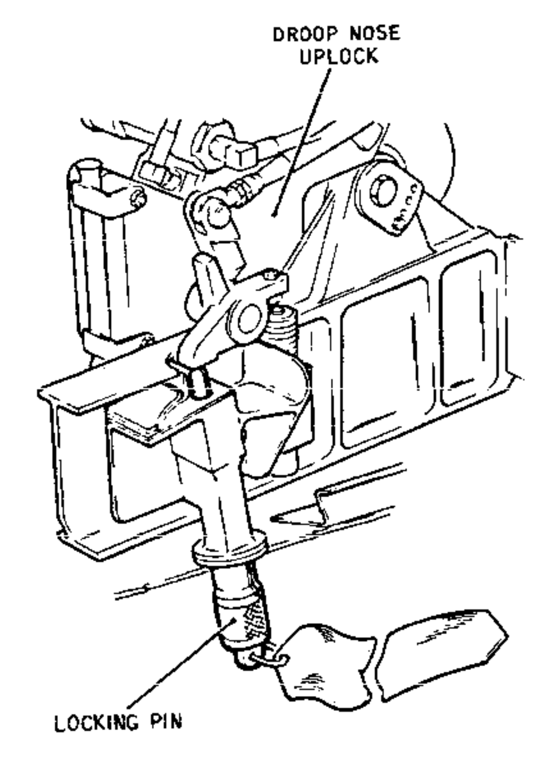
B. Prepare to Remove Rod (Ref. Fig.401 and 402)

(1) Trip the appropriate circuit breakers and secure them with safety clips.

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	ENG 1			
R	MAIN THROT CONT	3-213	1K3	A 1
R	ALTN THROT CONT	15-216	1K4	E 8
R	REV THRUST CONT	3-213	1K331	D 1
R	REHEAT CONT	15-216	1K1542	E 9
R	PP MGT LTS SUP	5-213	1E461	D 1
R	ENG 2			
R	MAIN THROT CONT	1-213	2K3	A 3
R	ALTN THROT CONT	15-215	2K4	F15
R	REV THRUST CONT	1-213	2K331	B 5
R	REHEAT CONT	15-215	2K1542	D15
R	REHEAT AMP SUP	13-215	2K1541	B14
R	PP MGT LTS SUP	1-213	2K461	E 3
R	ENG 3			
R	MAIN THROT CONT	1-213	3K3	A 4
R	ALTN THROT CONT	15-215	3K4	F16
R	REV THRUST CONT	1-213	3K331	B 6
R	REHEAT CONT	15-215	3K1542	D16
R	REHEAT AMP SUP	13-216	3K1541	B 7
R	PP MGT LTS SUP	1-213	3K461	E 4
R	ENG 4			
R	MAIN THROT CONT	3-213	4K3	A 2
R	ALTN THROT CONT	15-216	4K4	F11
R	REV THRUST CONT	3-213	4K331	D 2
R	REHEAT CONT	15-216	4K1542	E10
R	REHEAT AMP SUP	14-216	4K1541	D 7
R	PP MGT LTS SUP	5-213	4E461	D 2
R	AT SYS 1 SUP	13-215	1C179	C 6
R	AT SYNCHRO SYS 1 SUP	13-215	1C181	D 5
R	AT 1 CONT	1-213	1C180	012
R	AFCS 1 CONT	1-213	1C19	014
R	AT SYS 2 SUP	13-216	2C179	D16
R	AT SYNCHRO SYS 2 SUP	13-216	2C181	B17
R	AT 2 CONT	5-213	2C180	A14
R	AFCS 2 CONT	5-213	2C19	A12
R	CHART STOWAGE LIGHTS	15-216	L237	D12
R	NOSE 71/2 DEG CONT	1-213	M12	Q16
R	NOSE/VISOR STBY			
R	LOWER SUP	1-213	M13	Q17
R				

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Droop Nose Locking Pins
Figure 401

(2) Remove the centre console aft left-hand side panel:

(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilots' floor illumination at receptacle U 2026 on the panel.

(c) Remove the panel.

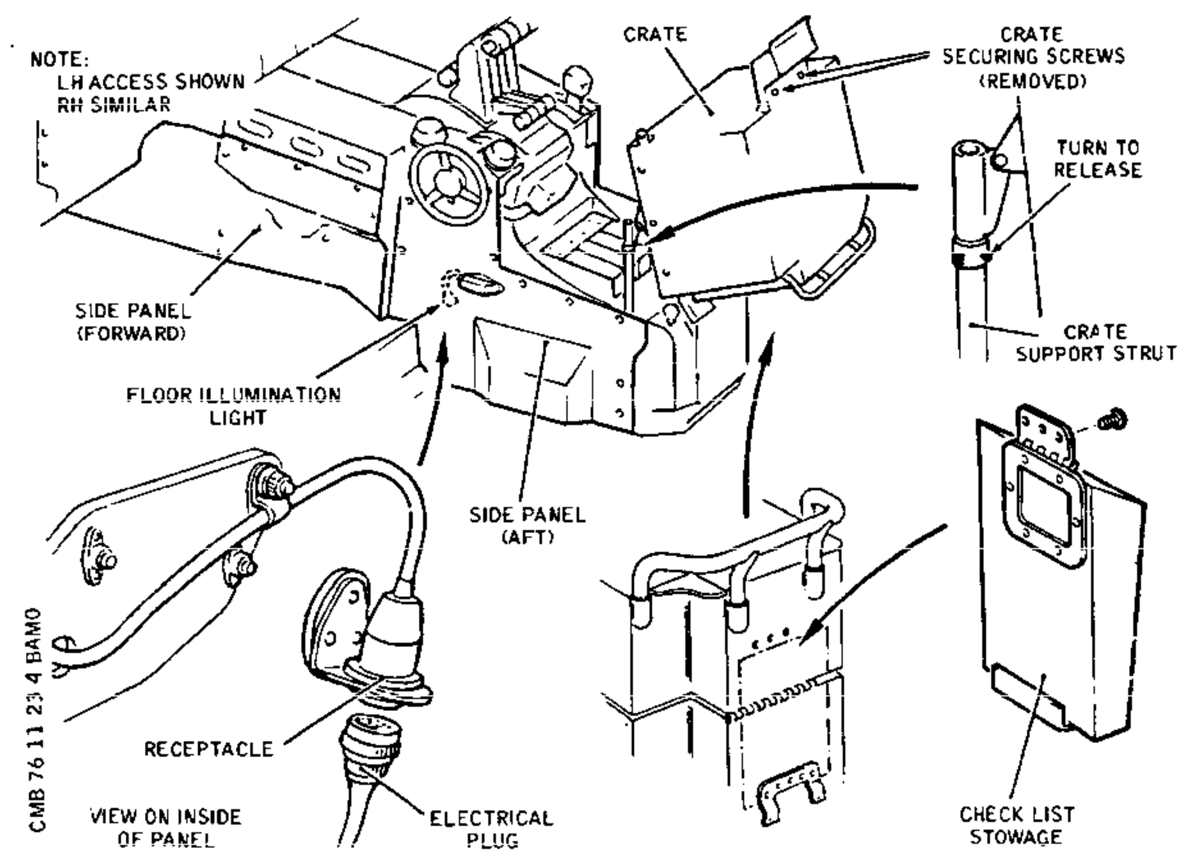
(3) Remove the droop nose emergency lever (Ref. Fig. 401).

NOTE: This can be done with the nose either up or down.

(a) If the nose is up fit locking pins (2) in the droop nose mechanism.

(b) Remove the quick release pin at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the lefthand side and depress the spring-loaded pin on the forward end of the droop nose emergency lever; remove the lever.



Centre Console - Access.
Figure 402

(4) Remove the centre console aft right-hand side panel in a manner similar to that described for the left-hand; the electrical plug is U 2025.

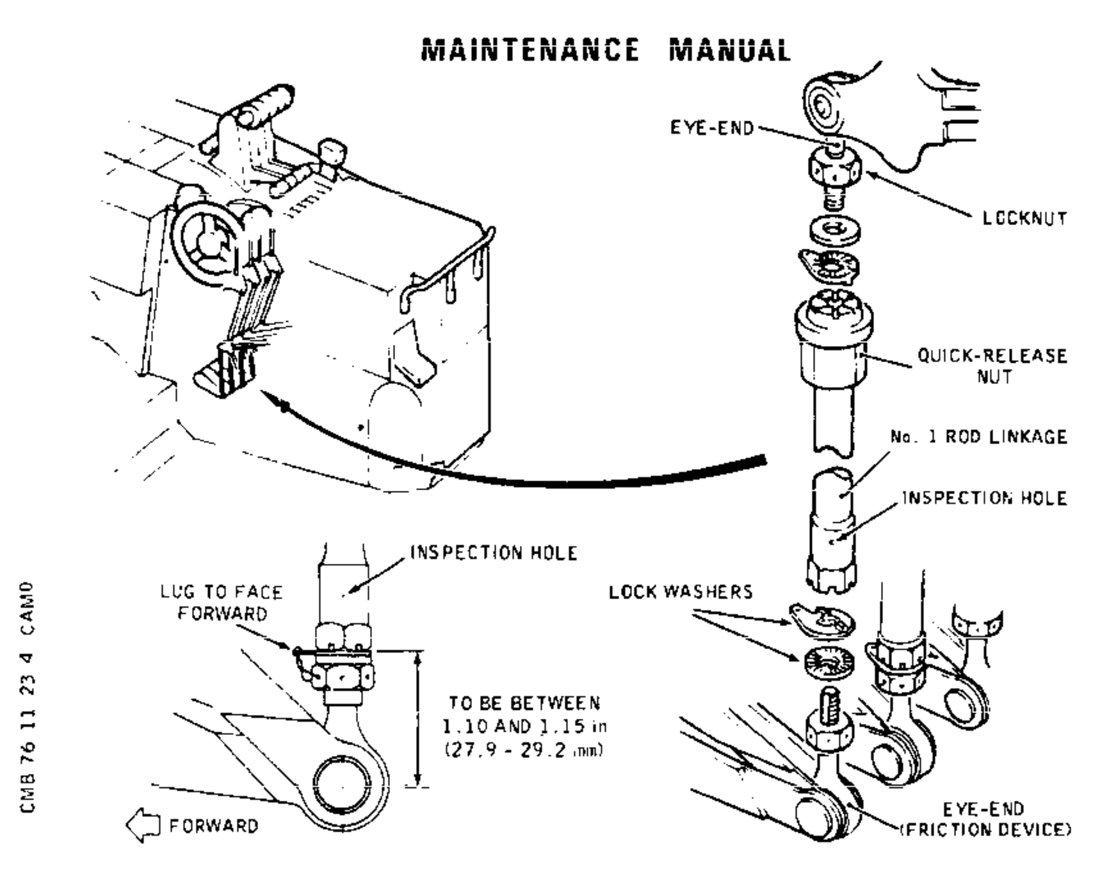
(5) Remove the centre console forward side panels.

(6) Remove the screws securing the check list stowage; remove the stowage.

(7) Remove the screws securing the crate; hinge back the crate.

C. Remove the Rod (Ref. Fig. 403).

(1) Unscrew the knurled nuts to extract the No. 1 throttle transmitter.



Rod linkage - Installation
Figure 403

(2) Disconnect the rod at the quick-release coupling:

(a) Remove the locking wire securing the quick-release nut.

(b) Slacken the locknut.

(c) Unscrew the quick-release nut until the connection is broken.

(3) Remove the wire, slacken the locknut, and unscrew the rod from the eye-end of the friction device; count the number of turns. Retain the locking washer.

D. Prepare to Install Rod.

(1) Comply with the electrical safety precautions.

(2) Comply with the droop nose safety precautions.

(3) Check the area in the centre console for cleanliness.

E. Install Rod (Ref. Fig. 403)

NOTE: Wirelock items, where specified in accordance with 20-21-13.

(1) Connect the rod:

(a) Install the two lockwashers and screw the rod onto the eye-end of the friction device, an estimated number of turns. Do not lock.

CAUTION: THE LUGS ON THE LOCKWASHERS MUST FACE FORWARD.

(b) With a locknut and two lockwashers loosely assembled on the transmitter eye-end, engage the quick-release nut and screw on a number of turns. Do not lock.

(2) Set the rod:

(a) Adjust the rod until the distance between the bottom face of the rod and the pin centre of the friction device eye-end is between 1.10 and 1.15 in (27.94 and 19.21 mm).

(b) Torque load the locknut to between 30 and 36 lbf in (0.34 and 0.4 mdaN), check that the setting has not altered, and wirelock the locknut.

(c) Ensure that the inspection hole in the rod is completely blocked by the threads.

(3) Secure the quick-release nut at the top of the rod linkage:

(a) With a locknut and two lockwashers loosely assembled on the eye-end, engage the quick-release nut and screw on until the rod bottoms.

CAUTION: WHEN TIGHTENING THE QUICK-RELEASE NUT ENSURE THAT THE LOAD IS NOT REACTED AGAINST THE BALL JOINT.

(b) Hold the eye end securely and torque load the nut to between 30 and 36 lbf in (0.34 and

0.4 mdaN).

(c) Arrange the locking washers in the slots of the quick-release nut.

CAUTION: THE LUGS ON THE LOCKWASHERS MUST FACE FORWARD.

(d) With a spanner on the quick-release nut tighten the locknut and torque load to between 10 and 15 lbf in (0.11 and 0.17 mdaN) and wirelock.

(4) Check the throttle friction (Ref. 76-11-00 Adjustment/Test).

(5) Install the throttle transmitter (Ref. 76-11-12 Removal/Installation).

F. Conclusion

(1) Check that the area is clean, release the locking struts, and hinge forward the crate. Insert the two securing screws and torque load them to between 70 and 80 lbf in (0.78 and 0.80 mdaN).

(2) Engage the check list stowage with the rear of the crate, fit and tighten the securing screws.

(3) Replace the centre console aft right-hand side panel:

(a) Check the panel seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilots' floor illumination at the receptacle identified U2025 on the panel.

(d) Torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(4) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the quick-release pin.

(5) Secure the centre console aft left-hand side panel in a manner similar to that described for the right-hand panel, the electrical plug is U 2026.

(6) Secure the centre console forward panels and

torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(7) Remove the locking pins (2) from the droop nose unlock mechanism and replace the access panel.

(8) Remove the safety clips and reset the circuit breakers previously tripped.

(9) Check transmitter input signals to the engine amplifiers (Ref. 76-11-00. Adjustment/Test).

FORWARD BAULK OVERRIDE MECHANISM - REMOVAL/INSTALLATION

1. General

A forward baulk override mechanism is located in the centre console, the operating handle being on sub-panel 3 on the right-hand side. The mechanism is accessible with the rear centre console side panels and the base of sub-panel 3 removed.

2. Baulk Override

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
R Torque spanner R 0 to 24 lbf in (0-0.28 mdaN).	-
Screwdriver torque limiting range: 0-79 lbf in. (0-0.89 mdaN)	-
Corrosion resistant steel wire R 0.031 in. (0.8 mm) dia.	-
Locking pins (droop nose)	E925045031
Grease, Aeroshell 16 (Ref. 20-30-00, No. 51)	-
R Loctite Superfast (Ref. R 20-30-00, No. 112)	-

B. Prepare (Ref. Fig.401 and 402)

NOTE: To improve access to the centre console it may be necessary to remove the co-pilots' seat (Ref. 25-11-21, Removal/Installation).

(1) Trip the appropriate circuit breakers and secure them with safety clips.

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	ENG.1			
R	MAIN THROT CONT.	3-213	1K3	A 1
R	ALT. THROT CONT.	15-216	1K4	E 8
R	REV THRUST CONT.	3-213	1K331	D 1
R	REV THRUST ASOV CONT	3-213	1K334	G 3
R	REHEAT CONT.	15-216	1K1542	E 9
R	PP MTG LTS SUP.	5-213	1E461	D 1
R	ENG. 2			
R	MAIN THROT CONT.	1-213	2K3	A 3
R	ALT THROT CONT.	15-215	2K4	F15
R	REV THRUST CONT.	1-213	2K331	B 5
R	REV THRUST ASOV CONT.	1-213	2K334	D 7
R	REHEAT CONT.	15-215	2K1542	D15
R	PP MTG LTS SUP.	1-213	2E461	E 3
R	ENG. 3			
R	MAIN THROT CONT.	1-213	3K3	A 4
R	ALT THROT CONT.	15-215	3K4	F16
R	REV THRUST CONT.	1-213	3K331	B 6
R	REV THRUST ASOV CONT.	1=213	3K334	D 8
R	REHEAT CONT.	15-215	3K1542	D16
R	PP MTG LTS SUP.	1-213	3E461	E 4
R	ENG. 4			
R	MAIN THROT CONT.	3-213	4K3	A 2
R	ALT THROT CONT.	15-216	4K4	F11
R	REV THRUST CONT.	3-213	4K331	D 2
R	REV THRUST ASOV CONT.	3=213	4K334	G 4
R	REHEAT CONT.	15-216	4K1542	E10
R	PP MTG LTS SUP.	5-213	4E461	D 2
R	AT SYS 1 SUP.	13-215	1C179	C 6
R	AT SYNCHRO SYS 1 SUP.	13-215	1C181	D 5
R	AT 1 CONT.	1-213	1C180	Q12
R	AFCS 1 CONT.	1-213	1C19	Q14
R	AT SYS 2 SUP.	13-216	2C179	D16
R	AT SYNCHRO SYS 2 SUP.	13-216	2C181	B17
R	AT 2 CONT.	5-213	2C180	A14
R	AFCS 2 CONT.	5-213	2C19	A12

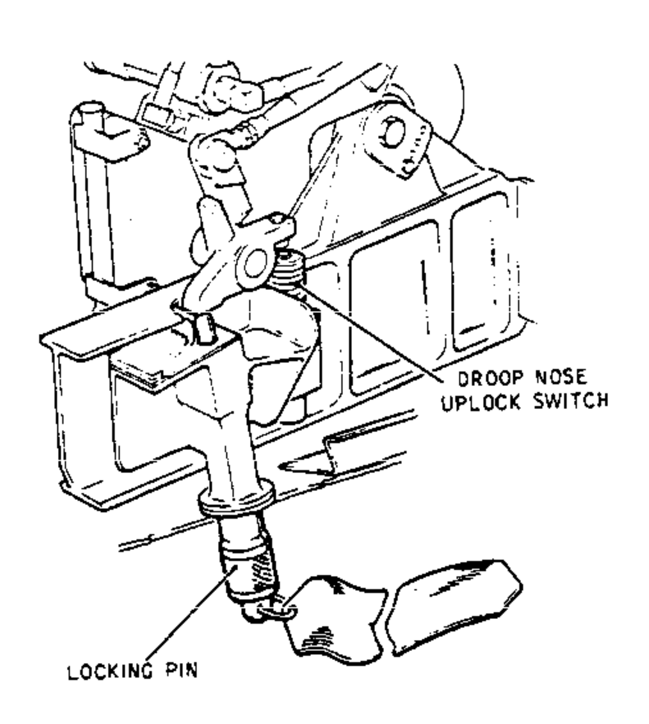
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	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	CHART STOWAGE LTS SUP.	15-216	L237	D12
R	NOSE 7 1/2 DEG. CONT.	1-213	M12	Q16
R	NOSE/VISOR STBY LOWER SUP.	1-213	M13	Q17
R	LH WINDSCREEN WIPER CONT.	1-213	1H72	J 8
R	RH WINDSCREEN WIPER CONT.	15-216	2H72	A15
R	LH RAIN REPEL CONT.	15-215	1H63	A11
R	RH RAIN REPEL CONT.	15-216	2H63	A16
R				

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PANEL
113 CB

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Droop Nose Locking Pins
Figure 401

(2) Remove the centre console aft left-hand side panel:

(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilots'

floor illumination at the receptacle identified U2026 on the panel.

(c) Lift the panel spigots clear of the floor and remove the panel.

(3) Remove the droop nose emergency lever
R (Ref. Fig. 401).

NOTE: This can be done with the nose either up or down.

(a) If the nose is up, fit locking pins (2) to the droop nose uplocks.

R (b) Using the ring, pull the handle outwards at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the
R left-hand side and depress the spring-loaded pin on the forward end of the droop nose emergency lever; remove the lever.

(4) Remove the centre console aft right-hand side panel in a manner similar to that described for the left-hand; the electrical plug identification is U2025.

C. Remove (Ref. Fig. 403)

(1) Remove the base of sub-panel 3.

(a) Disconnect the plug UA2063.

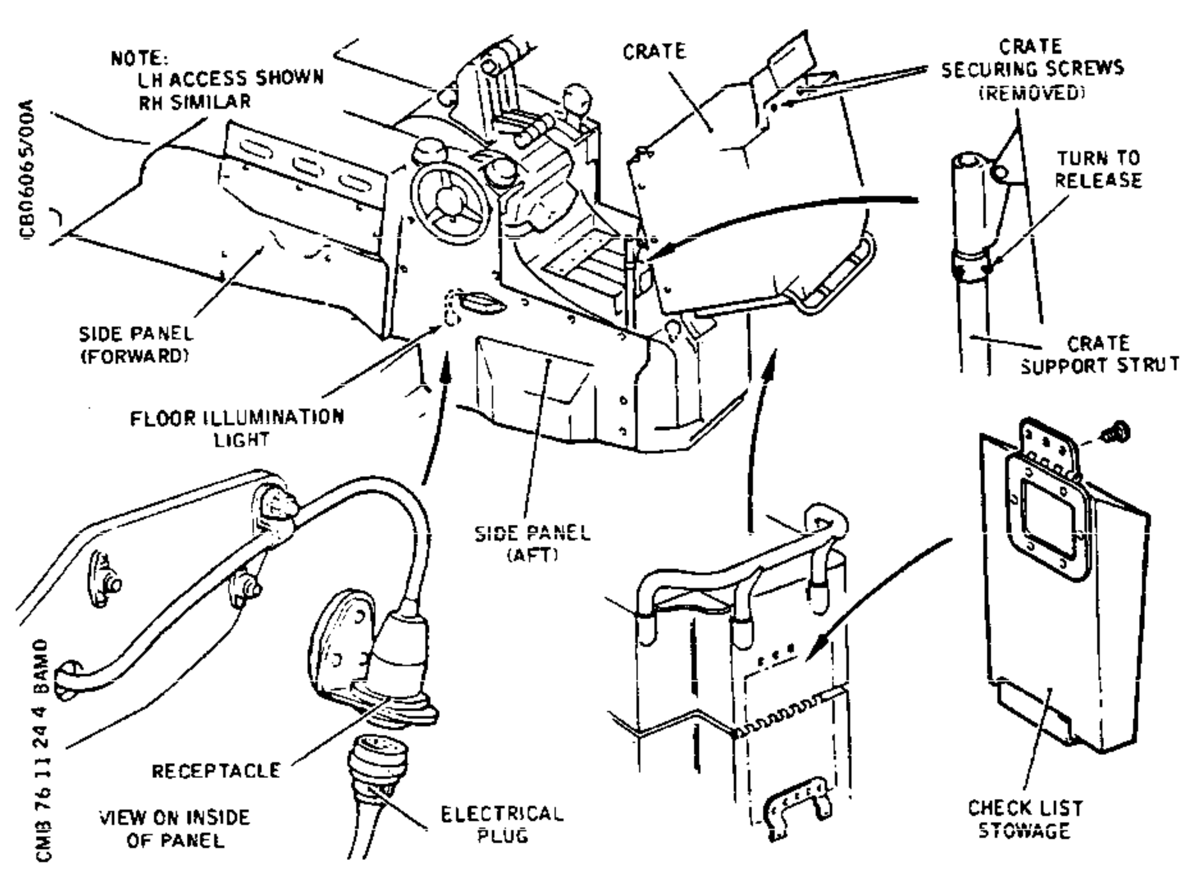
(b) Remove the bolt assembly in the baulk O/ride lever.

(c) Remove the panel base securing screws (3), remove the panel base.

(2) Hold the handle and unscrew the shaft from the handle; retain the spring and washers (4), and remove the shaft and the handle.

R (3) Remove the locking wire and the two spring pins securing the lever to the shaft.

NOTE: The spring pins are not tapered and may be pushed or driven out using a hammer and a pin punch, if accessible, or a locally manufactured extraction tool.



Centre Console - Access
Figure 402

CAUTION: ENSURE THAT THE SPRING PINS ARE NOT DROPPED, THEY MAY BE DIFFICULT TO RECOVER AND IF LOST COULD JAM FLYING CONTROLS.

(4) Remove the locking wire and the three spring pins securing the striker to the shaft assembly.

(5) Remove the collar and shaft assembly from the left-hand side of the centre console; retain the striker plate.

R R R NOTE: The striker plate should be quite free on the shaft but if tight may be due to burrs on the shaft.

D. Prepare to Install (Ref. Fig.401 and 402)

(1) Comply with the electrical safety precautions.

(2) Check the area in the centre console for cleanliness.

E. Install (Ref. Fig. 403)

R NOTE: Torque-tighten bolts (Ref. 20-21-11)

Split pin nut/bolts (Ref. 20-21-12)

R Loctite sub-panel screws (Ref. 20-25-11)

(1) Install the shaft and collar assembly from the left-hand side of the centre console casting, engage the striker plate with the shaft and push or drive the shaft through the striker plate and the hole in the right-hand side of the casting.
R Inside the casting, align the striker plate with the holes in the shaft. Insert the spring pins (3) in the striker plate and shaft, and lock each spring pin with wire.

CAUTION: THE WIRE IS THREADED THROUGH THE HOLES IN THE SPRING PINS AND LOCKED ROUND THE SHAFT ASSEMBLY. CHECK THAT THE WIRE CANNOT PASS THROUGH THE SLOT IN THE INSTALLED PINS.

(2) Engage the lever with the shaft, align the holes, in the lever and shaft and insert a spring pin in each hole. Lock each spring pin with wire as previously described.

(3) Loosely install the handle and shaft:

(a) Apply a smear of grease Aeroshell 16 to the threads on the shaft and to the cam face of the handle.

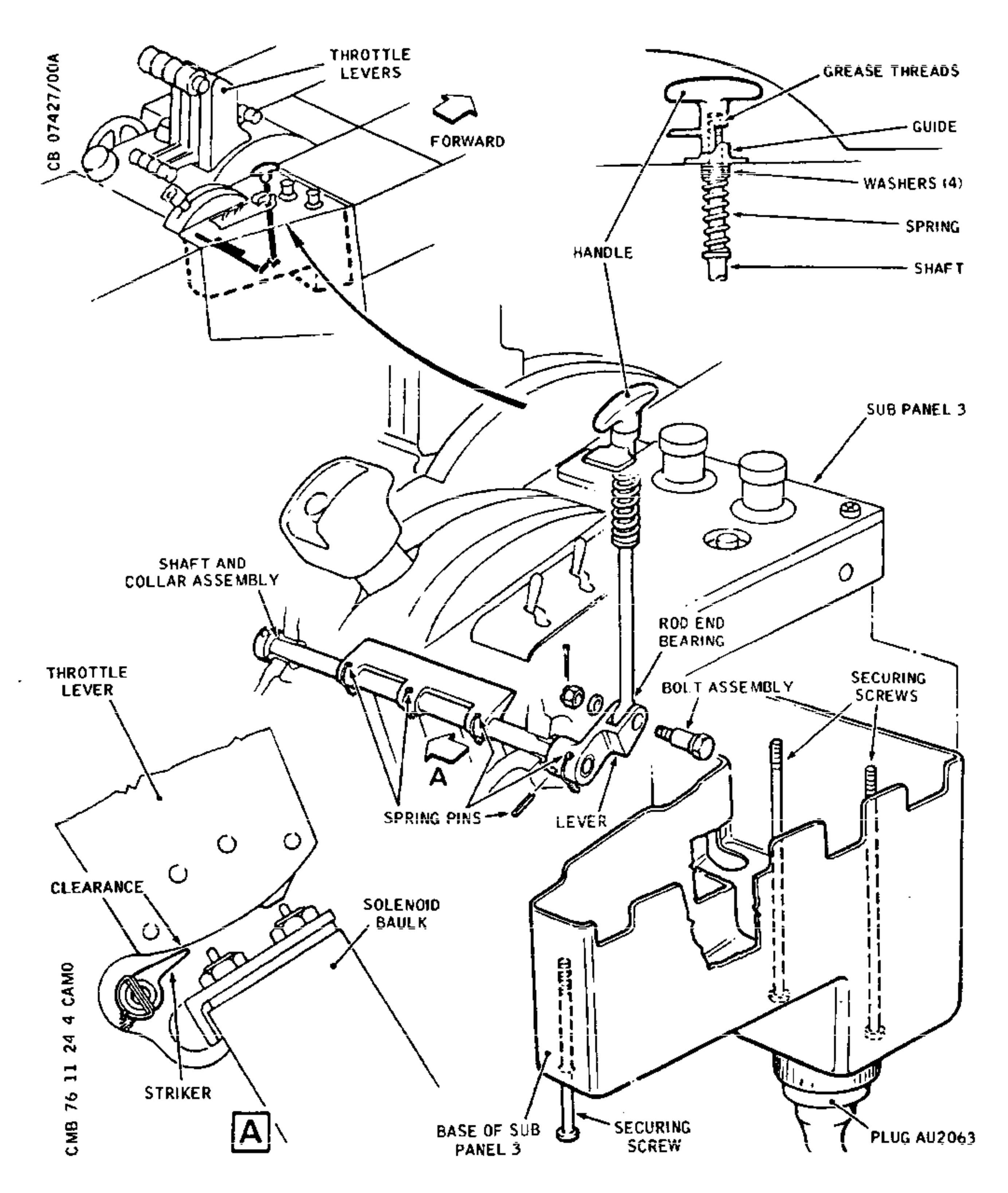
(b) Thread the spring and washers (4) on the shaft and engage the shaft with the handle through the hole in the handle guide.

(c) Screw the shaft into the handle a nominal number of turns.

(4) Adjust:

(a) Lift and turn fully clockwise the 'BAULK O/RIDE' handle, so that the handle rests on the top face of the guide.

(b) Move a throttle lever forward to within 1.0 in (25.4 mm) approx. of the maximum stop position.



Forward Baulk Override Mechanism - Installation
Figure 403

(c) Raise the lever, as far as it will move, and hold it in this position (Detail A).

(d) Hold the handle and screw in the shaft until the holes on the lever fork and the rod end bearing on the shaft are aligned; insert the bolt assembly.

(e) Temporarily remove the bolt assembly and unscrew the shaft from the handle one half turn.

NOTE: This will give a clearance at Detail A.

(f) Secure the shaft to the lever with the bolt
R assembly, washer and nut. Torque-load the
R bolt to between 20 and 25 lbf in. (0.23-0.28 mdaN) and lock with a split pin.

(g) Turn the "BAULK O/RIDE" handle anti-clockwise and check that the tongue drops into the slot. Test in accordance with 76-11-24, Adjustment/ Test.

(5) Carry out a Duplicate Inspection of the adjustment and test detailed in operation (4).

F. Conclusion

(1) Re-connect the base of sub-panel 3:

(a) Engage the sub-panel base with the panel and secure it with the three screws. Lock the screws
R with loctite (Ref. 20-25-11).

(b) Check that the pins are clean and undamaged and connect the electrical plug UA2063 to the panel.

(2) Replace the centre console aft right-hand side panel:

(a) Check the panel seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilots' floor illumination at the receptacle identified U2025 on the panel.

(d) Torque tighten the panel screws to between
R 40 and 45 lbf in (0.45 and 0.51 mdaN).

(3) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the quick-release pin.

(4) Secure the centre console aft left-hand side panel in a manner similar to that described for the right-hand panel, the electrical plug is identified U2026.

(5) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf
R in (0.45 and 0.51 mdaN).

(6) If necessary, replace the copilots' seat (Ref. 25-11-21, Removal/Installation).

(7) Remove the locking pins (2) from the droop nose.

(8) Remove the safety clips and reset the circuit breakers previously tripped.

(9) Carry out an operational test on the throttles (Ref. 76-11-00, Adjustment/Test).

(10) Carry out operational tests on the services from sub-panel 3:

(a) Visor and droop nose (Ref.27-61-00).

(b) Windscreen wipers (Ref. 30-42-00).

(c) Rain repellant systems (Ref. 30-42-00).

FORWARD BAULK OVERRIDE MECHANISM - ADJUSTMENT/TEST

1. General

The forward baulk override is located on sub-panel 3 to the right of the centre console. To adjust the mechanism it is necessary to remove the rear right-hand side panel from the centre console.

2. Adjustment

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Screwdriver torque limiting range: 0-79 lbf in (0-0.89 mdaN)	-
Locking pins (droop nose)	E925045031

B. Prepare (Ref. Fig.501 and 502)

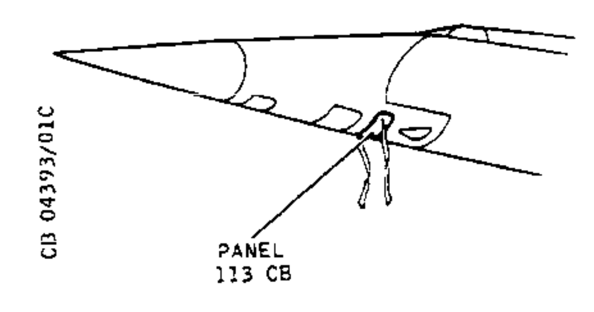
NOTE: To improve access to the centre console it may be necessary to remove the co-pilots' seat (Ref. 25-11-21, Removal/Installation).

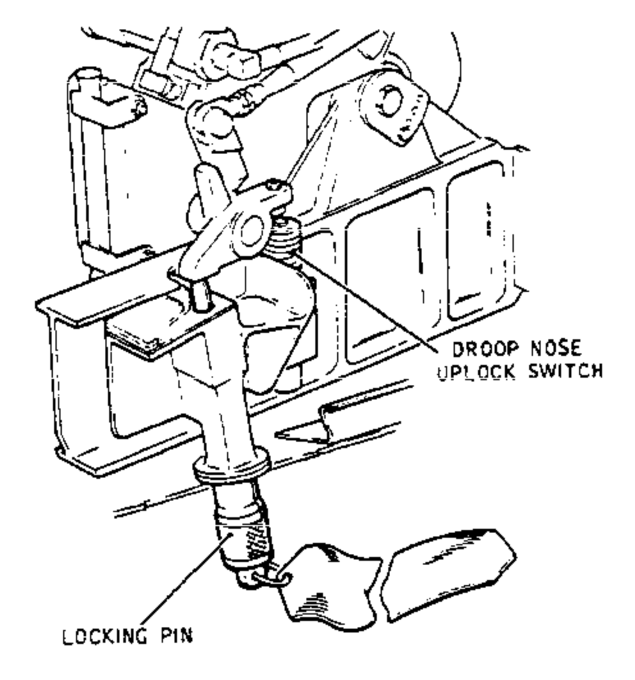
(1) Trip the appropriate circuit breakers and secure them with safety clips.

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	AT SYS 1 SUP.	13-215	1C179	C 6
R	AT SYNCHRO SYS 1 SUP.	13-215	1C181	D 5
R	AT 1 CONT.	1-213	1C180	Q12
R	AFCS 1 CONT.	1-213	1C19	Q14
R	AT SYS 2 SUP.	13-216	2C179	D16
R	AT SYNCHRO SYS 2 SUP.	13-216	2C181	B17
R	AT 2 CONT.	5-213	2C180	A14
R	AFCS 2 CONT.	5-213	2C19	A12
R	CHART STOWAGE LTS SUP.	15-216	L237	D12
R	NOSE 7 1/2 deg/CONT.	1-213	M12	Q16
R	NOSE/VISOR STBY LOWER SUP.	1-213	M13	Q17

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R	LH WINDSCREEN WIPER CONT.	1-213	1H72	J8
R	RH WINDSCREEN WIPER CONT.	15-216	2H72	A15
R	LH RAIN REPEL CONT.	15-215	1H63	A11
R	RH RAIN REPEL CONT.	15-216	2H63	A16
R	ENG. 1			
R	MAIN THROT CONT.	3-213	1K3	A 1
R	ALT.THROT CONT.	15-216	1K4	E 8
R	REV THRUST CONT.	3-213	1K331	D 1
R	REV THRUST ASOV CONT.	3-213	1K334	G 3
R	REHEAT CONT.	15-216	1K1542	E 9
R	PP MTG LTS SUP.	5-213	1E461	D 1
R	RATING CONT.	3-213	1K8	C 3
R	ENG. 2			
R	MAIN THROT CONT.	1-213	2K3	A 3
R	ALT THROT CONT.	15-215	2K4	F15
R	REV THRUST CONT.	1-213	2K331	B 5
R	REV THRUST ASOV CONT.	1-213	2K334	D 7
R	REHEAT CONT.	15-215	2K1542	D15
R	PP MTG LTS SUP.	1-213	2E461	E 3
R	RATING CONT	1-213	2K8	E 8
R	ENG. 3			
R	MAIN THROT CONT.	1-213	3K3	A 4
R	ALT THROT CONT.	15-215	3K4	F16
R	REV THRUST CONT.	1-213	3K331	B 6
R	REV THRUST ASOV CONT.	1-213	3K334	D 8
R	REHEAT CONT.	15-215	3K1542	D16
R	PP MTG LTS SUP.	1-213	3E461	E 4
R	RATING CONT	1-213	3K8	E 2
R	ENG. 4			
R	MAIN THROT CONT.	3-213	4K3	A 2
R	ALT THROT CONT.	15-216	4K4	F 9
R	REV THRUST CONT.	3-213	4K331	D 2
R	REV THRUST ASOV CONT.	3-213	4K334	G 4
R	REHEAT CONT.	15-216	4K1542	E10
R	PP MTG LTS SUP.	5-213	4E461	D 2
R	RATING CONT	3-213	4K8	C 4
R				

(2) Remove the centre console aft left-hand side panel:





Droop Nose Locking Pins
Figure 501

(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilots' floor illumination at the receptacle identified U2026 on the panel.

R (c) Lift the panel spigots clear of the floor and
R remove the panel.

(3) Remove the droop nose emergency lever (Ref. Fig. 501).

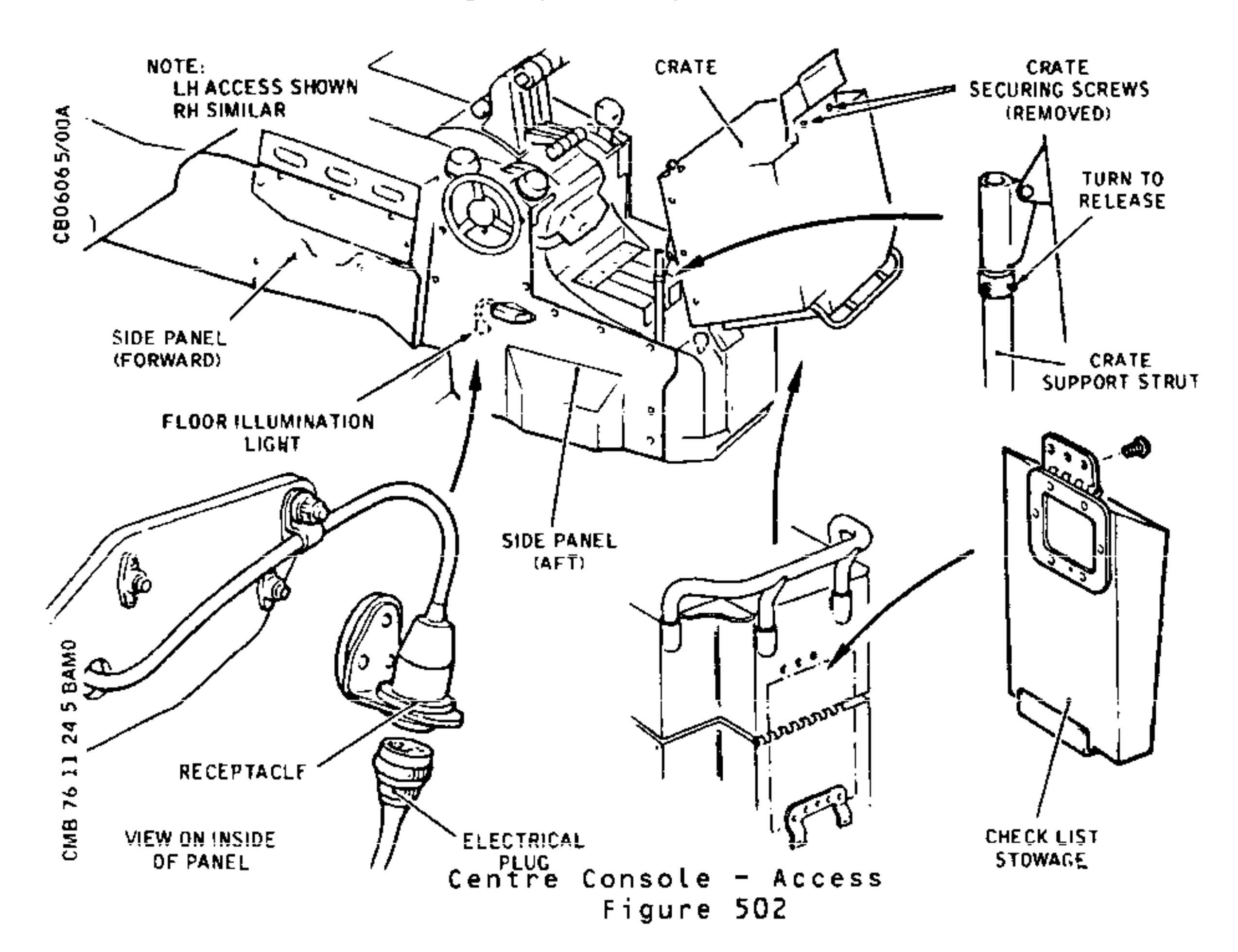
<u>NOTE</u>: This can be done with the nose either up or down.

(a) If the nose is up, fit locking pins (2) in the droop nose mechanism.

(b) Using the ring pull the release pin outwards at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the

lefthand side and depress the spring-loaded pin on the forward end of the droop nose emergency lever; remove the lever.



Centre Console - Access
Figure 502

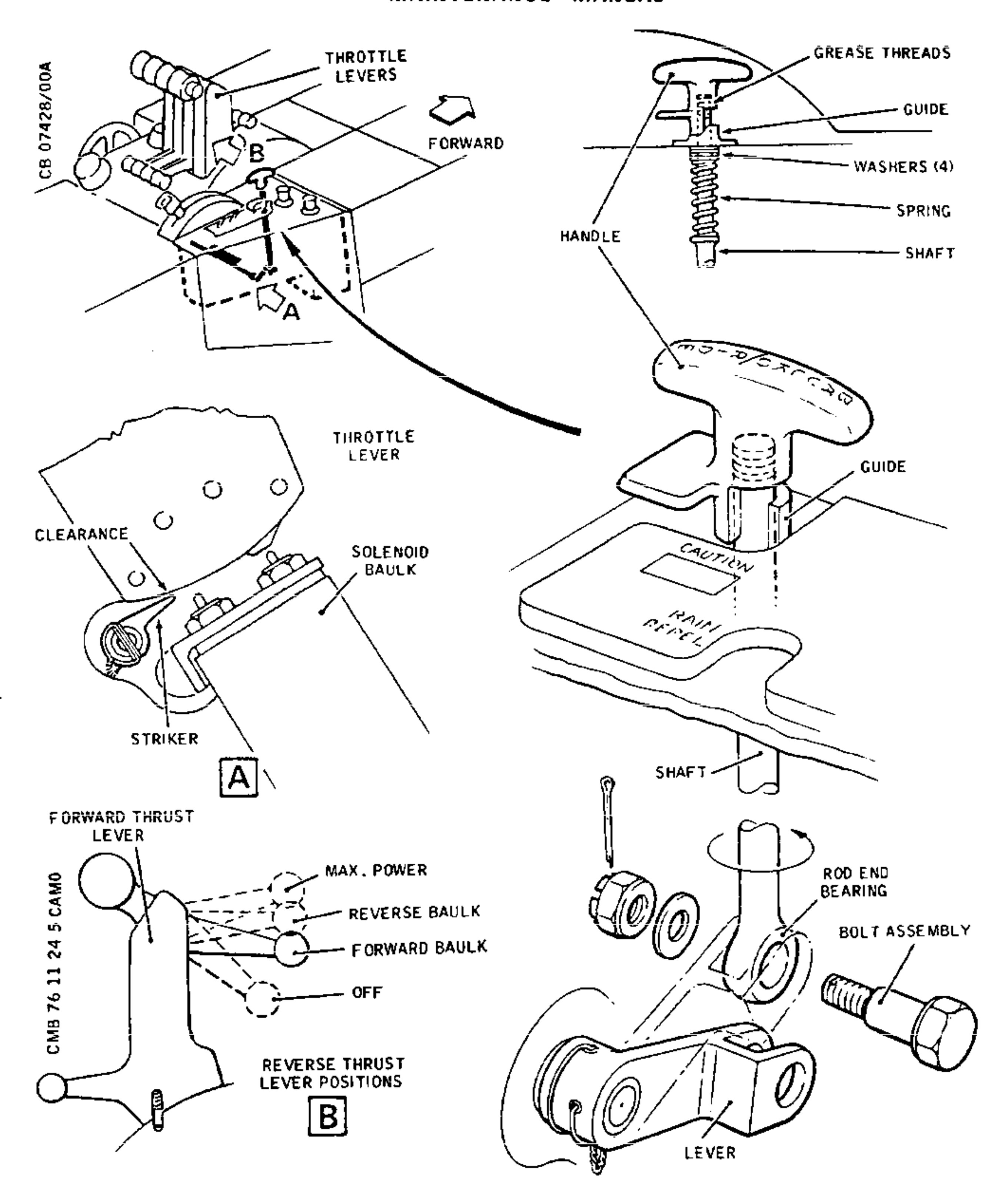
(4) Remove the centre console aft right-hand side panel in a manner similar to that described for the left-hand; the electrical plug identification is U2025.

C. Adjust (Ref. Fig. 503)

(1) Below sub-panel 3, remove the split pin, nut and the bolt assembly securing the lever to the shaft.

(2) Lift and fully turn clockwise the 'BAULK O/RIDE handle, so that the handle rests on the top face of the handle guide against the stop.

(3) Move a throttle lever forward to within approximately 1.0 in (25.4 mm) of the maximum r.p.m. stop position.



Forward Baulk Override - Adjustment
Figure 503

(4) Raise the lever, as far as it will move, and hold it in this position (detail A).

(5) Hold the handle and screw in on the shaft until the holes on the lever fork and the rod end bearing on the shaft are aligned; insert the bolt assembly.

(6) Temporarily remove the bolt assembly and unscrew the shaft from the handle one half turn.

(7) Secure the shaft to the lever with the bolt assembly, washer and nut. Torque load the bolt to between 20 and 25 lbf in (0.23 - 0.29 mdaN) and lock with a split pin.

(8) Turn the knob counter clockwise and allow the tongue of the handle to drop into the slot. Test in accordance with para 3.

D. Conclusion

(1) Replace the centre console aft right-hand side panel:

(a) Check the panel seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilots' floor illumination at the receptacle identified U2025 on the panel.

(d) Torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(2) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the release pin.

(3) Secure the centre console aft left-hand side panel in a manner similar to that described for the right-hand panel, the electrical plug is identified U2026.

(4) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(5) If necessary, replace the co-pilots' seat (Ref. 25-11-21, Removal/Installation).

(6) Remove the locking pins (2) from the droop nose.

(7) Remove the safety clips and reset the circuit

breakers previously tripped.

(8) Carry out an operational test on the throttles (Ref. 76-11-00, Adjustment/Test).

3. Test

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
28V dc supply	-

B. Prepare

(1) Trip the appropriate circuit breakers and secure them with safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG. 1			
MAIN THROT CONT.	3-213	1K3	A 1
ALT.THROT CONT.	15-216	1K4	E 8
REV THRUST CONT.	3-213	1K331	D 1
REV BUCKET POSN IND.	5-213	1E121	A 3
ENG. 2			
MAIN THROT CONT.	1-213	2K3	A 3
ALT THROT CONT.	15-215	2K4	F15
REV THRUST CONT.	1-213	2K331	B 5
REV BUCKET POSN IND	1-213	2E121	B 7
ENG. 3			
MAIN THROT CONT.	1-213	3K3	A 4
ALT THROT CONT.	15-215	3K4	F16
REV THRUST CONT.	1-213	3K331	B 6
REV BUCKET POSN IND	1-213	3E121	B 8

R

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG. 4			
MAIN THROT CONT.	3-213	4K3	A 2
ALT THROT CONT.	15-216	4K4	F 9
REV THRUST CONT.	3-213	4K331	D 2
REV BUCKET POSN IND	5-213	4E121	A 4

(2) Ensure that a ground air supply is not connected to the two exhaust system ground connections, one located each side of the rear engine bay centre wall. Also place a Warning placard near the ground connections stating that an air supply must not be connected.

C. Test (Ref. Fig. 501)

(1) Locate the forward BAULK O/RIDE handle on the right-hand side of the centre console. Check that the handle is secured correctly in the handle guide.

NOTE: The handle is to be fully counter-clockwise and down.

(2) Move a throttle lever forward to within 1.0 in (25.4 mm) of the maximum r.p.m. stop position.

(3) Check the return action of the BAULK O/RIDE handle:

(a) Raise and turn the handle fully clockwise; the movement should be quite free.

(b) Turn the handle counter clock-wise and allow it to drop into the slot. Check for freedom of movement and that the handle seats securely in the guide in the fully down position.

(4) Check the operation of the forward baulk override:

(a) Set the throttle lever to 'idle'.

(b) Raise the reverse thrust levers against the reverse baulks.

(c) Move the reverse thrust lever forward, towards the off position, against the forward baulk.

(d) Raise and turn the forward BAULK O/RIDE handle fully clock-wise.

(e) Move the reverse thrust lever to the off, fully down, position.

NOTE: This proves that the forward baulks are tripped.

(5) Reset the BAULK O/RIDE handle.

R (6) Carry out a Duplicate Inspection of the adjustment
R and test.

D. Conclusion

(1) Ensure that the area around the centre console is clean.

(2) Remove the safety clips and reset the circuit breakers previously tripped.

(3) Remove the warning placard from the nozzle ground test connection.

LEVER ASSEMBLY AND TURNBUCKLE - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

A lever assembly and turnbuckle joins each throttle lever to a forward thrust switch pack located inside the centre console at floor level.

This procedure describes the Removal/Installation of No.1 lever assembly and turnbuckle. The other lever assemblies are removed in a similar manner.

2. Lever Assembly and Turnbuckle

A. Equipment and Materials

R	DESCRIPTION	PART NO.
R	Circuit breaker safety clips	-
R	Screwdriver, torque limiting	-
R	0-80 lbf in (0-0.78 mdaN)	-
R	Torque spanners range:	
R	0-60 lbf in (0-0.67 mdaN)	-
R	Corrosion resistant steel wire	
R	0.028 in (0.71mm) dia	-
R	Locquic N (Ref. 20-30-00, No.120)	-
R	Loctite C (Ref.20-30-00, No.111)	-

B. Prepare to Remove Lever Assembly and Turnbuckle (Ref. Fig.401 and 402)

NOTE: To improve access to the centre console it may be necessary to remove the co-pilot's seat (Ref. 25-11-21, Removal/Installation).

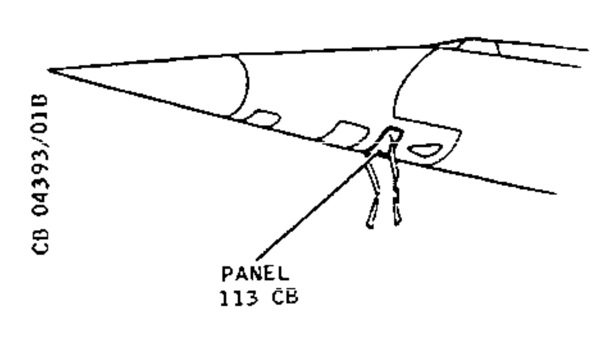
(1) Trip the appropriate circuit breakers and secure them with safety clips.

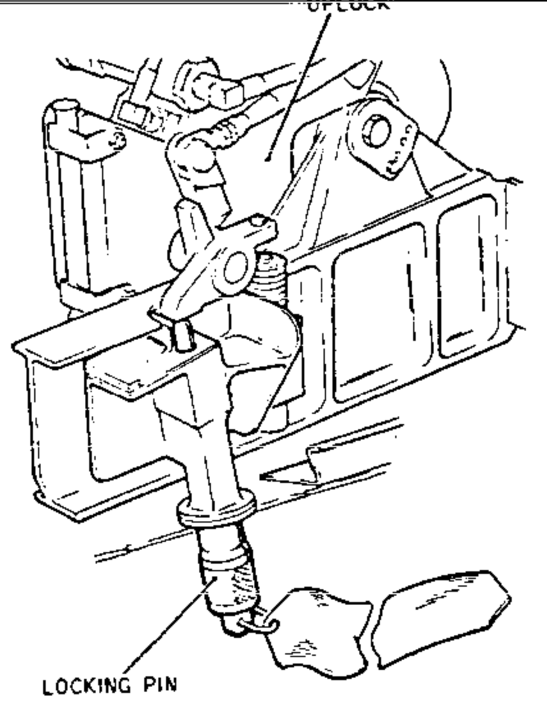
R

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
MAIN THROT CONT	3-213	1K3	A 1
ALTN THROT CONT	15-216	1K4	E 8
REV THRUST CONT	3-213	1K331	D 1
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C13
PP MGT LTS SUP	5-213	1E461	D 1
ENG 2			
MAIN THROT CONT	1-213	2K3	A 3
ALTN THROT CONT	15-215	2K4	F15
REV THRUST CONT	1-213	2K331	B 5
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	13-215	2K1541	B14
PP MGT LTS SUP	1-213	2E461	E 3
ENG 3			
MAIN THROT CONT	1-213	3K3	A 4
ALTN THROT CONT	15-215	3K4	F16
REV THRUST CONT	1-213	3K331	B 6
REHEAT CONT	15-215	3K1542	D16
REHEAT AMP SUP	13-216	3K1541	B 7
PP MGT LTS SUP	1-213	3E461	E 4
ENG 4			
MAIN THROT CONT	3-213	4K3	A 2
ALTN THROT CONT	15-216	4K4	F11
REV THRUST CONT	3-213	4K331	D 2
REHEAT CONT	15-216	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7
PP MGT LTS SUP	5-213	4E461	D 2
AT SYS 1 SUP	13-215	1C179	C 6
AT SYNCHRO SYS 1 SUP	13-215	1C181	D 5
AT 1 CONT	1-213	1C180	Q12
AFCS 1 CONT	1-213	1C19	Q14
AT SYS 2 SUP	13-216	2C179	D16
AT SYNCHRO SYS 2 SUP	13-216	2C181	B17
AT 2 CONT	5-213	2C180	A14
AFCS 2 CONT	5-213	2C19	A12
CHART STOWAGE			
LTS SUP	15-216	L237	D12

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SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
NOSE 7 1/2 DEG CONT	1-213	M12	Q16
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17





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Droop Nose Locking Pins
Figure 401

(2) Remove the centre console aft left-hand side panel:

(a) Release the screws securing the panel.

(b) Disconnect the electrical plug for the pilot's floor illumination at the receptacle identified U2026 on the panel.

(c) Lift the panel clear of the spigots and remove

the panel.

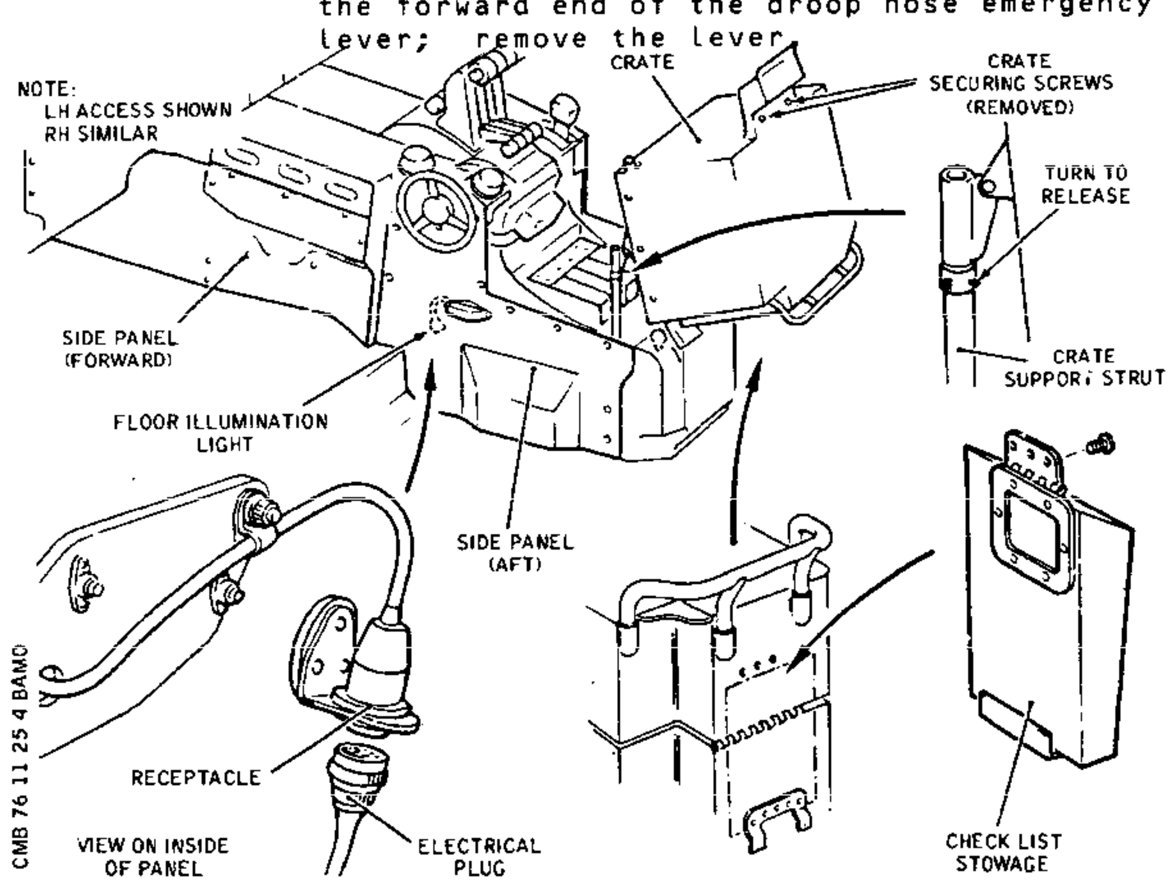
(3) Remove the droop nose emergency lever (Ref. Fig. 401).

NOTE: This can be done either with the nose up or down.

(a) If the nose is up, fit safety pins (2) in the droop nose mechanism.

(b) Remove the quick-release pin at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the left-hand side and depress the spring-loaded pin on the forward end of the droop nose emergency lever; remove the lever.



R Centre Console - Access
Figure 402

(4) Remove the centre-console aft right-hand side panel in a manner similar to that described for the left-

hand; the electrical plug identification is U2025.

(5) Remove the centre console forward side panels.

(6) Remove the screws securing the check list stowage; remove the stowage.

(7) Remove the screws securing the crate; hinge back the crate.

C. Remove the Lever Assembly Turnbuckle (Ref. Fig. 403)

(1) Release the fasteners securing the SELCAL control unit forward of the throttle gate. Remove the unit and lay it to one side; do not disturb the electrical connection.

(2) Remove the screws securing the throttle gate forward stop assembly; remove the assembly.

(3) Disconnect the lever assembly at the No.1 throttle lever:

(a) Remove the locking wire from both turnbuckle locknuts.

(b) Slacken both locknuts.

(c) Unscrew the turnbuckle until the lever assembly is disconnected from the eye-end of the throttle lever. Retain the lockwashers. Note the number of turns.

(4) Disconnect the No.1 forward thrust switch pack, (Ref. 76-15-12, Removal/Installation), and move it sufficiently to disengage the bottom end of the lever. Do not disturb the electrical connections. Remove the lever assembly.

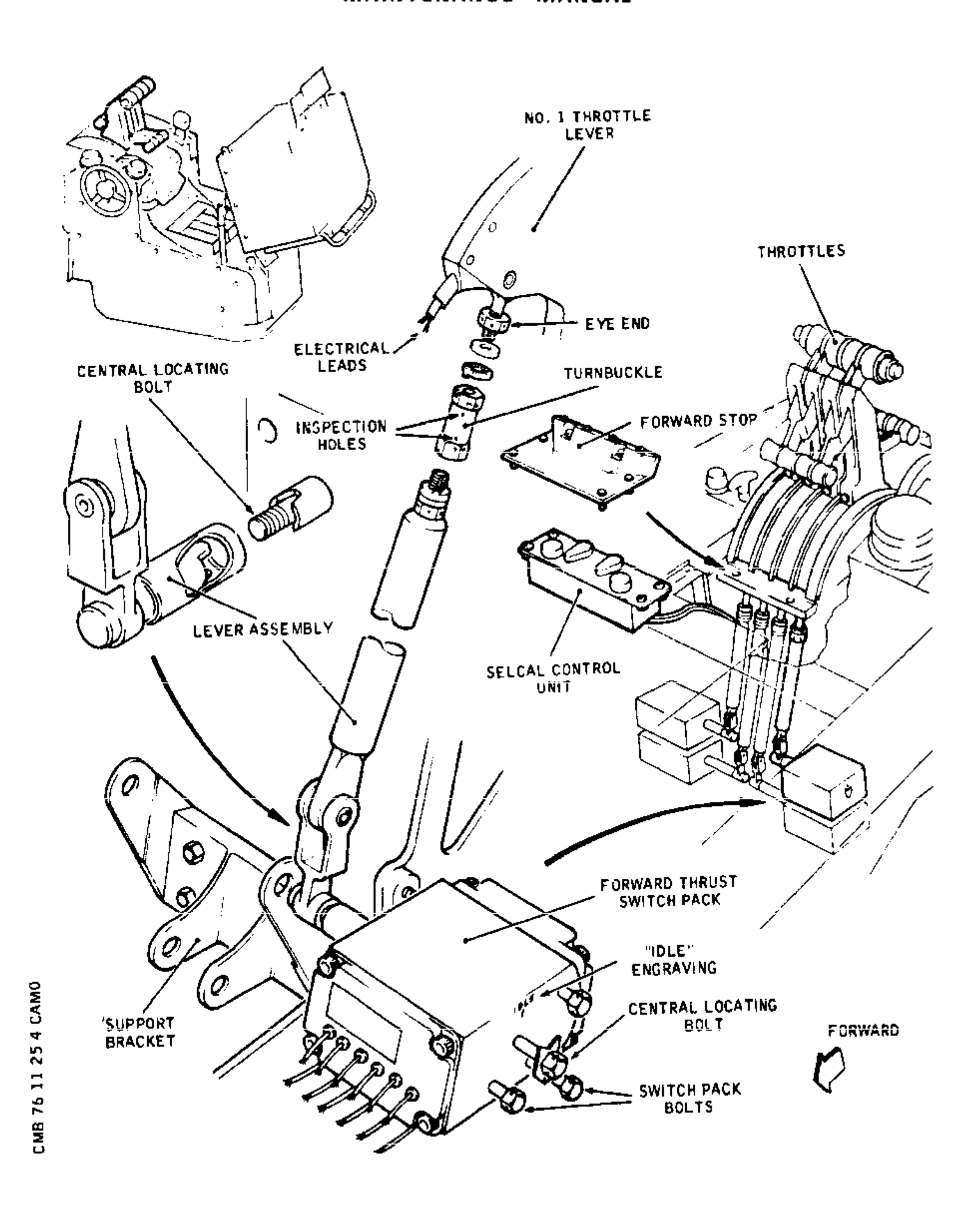
(5) Tighten the switch pack bolts just sufficiently to support the switch pack.

D. Prepare to Install the Lever Assembly and Turnbuckle:

(1) Comply with the electrical safety precautions.

(2) Comply with the droop nose safety precautions.

(3) Check that the area inside the centre console is clean.



R Lever Assembly Installation
Figure 403

E. Install the Lever Assembly and Turnbuckle (Ref. Fig. 403)

(1) Connect the lever assembly to the No.1 throttle lever:

(a) Screw on a locknut and engage two lockwashers with the top of the lever assembly.

(b) Check that there is a locknut on the eye-end of the throttle lever and engage two lockwashers.

(c) Engage the turnbuckle with the eye-end of the throttle lever and with the lever assembly and
R screw on the previously counted number of turns.

(2) Connect the lever to the forward thrust switch pack:

(a) Engage the bottom end of the lever assembly with the support bracket.

(b) Move the throttle lever to 'idle' rpm.

(c) Set the switch pack pointer approximately to 'idle'.

(d) Engage the quill shaft between the central locating bolt and the lever assembly.

(e) Refit the switch pack attachment bolts, tighten and lock (Ref. 76-15-12, Removal/Installation).

(3) Adjust the lever assembly:

(a) With the throttle lever held lightly at idle rpm adjust the turnbuckle until the centre of the recess, on the switch pack locating bolt, is aligned with the 'IDLE' line engraved on the switch pack.

NOTE: This is only a coarse adjustment.

(4) Carry out a fine adjustment on the lever assembly by checking that the switches make and break in the specified tolerance zones (Ref. 76-15-12, Removal/Installation).

(5) Arrange the lock washers at the turnbuckle ends
R and torque tighten each locknut to between 50 and
R 60 lbf in (0.56 and 0.67 mdaN).

CAUTION: WHEN TIGHTENING THE LOCKNUTS ENSURE THAT

THE LOAD IS NOT REACTED AGAINST THE SPHERICAL JOINTS.

(6) Lock each locknut to the turnbuckle with locking wire.

(7) Check that the inspection holes in the turnbuckle are blocked by the screw threads.

(8) Check that the lever has adequate rotational freedom on its spherical joints.

(9) Secure the throttle gate forward stop:

(a) Engage this forward stop assembly on the locating dowels and with the forward end of the throttle gate.

(b) Smear Locqnic N and Loctite grade C (Ref. 20-25-11) on the threads of the four bolts and screw them into the forward stop assembly.

(c) Torque tighten the bolts to between 50 and 60 lbf in (0.56 and 0.67 mdaN).

(d) Secure the forward end of the throttle gate in the forward stop with the bolts (2). Torque tighten them to between 40 and 45 lbf in (0.45 and 0.51 mdaN).

(10) Check that the area is clean and replace the SELCAL control unit forward of the throttle gate and secure it with the fasteners.

E. Conclusion

(1) Check that the area is clean, release the locking struts, and hinge forward the crate. Insert the two securing screws and torque load them to between 70 and 80 lbf in (0.78 and 0.89 mdaN).

(2) Engage the check list stowage with the rear of the crate, fit and tighten the securing screws.

(3) Replace the centre console aft right-hand side panel:

(a) Check the panel seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilot's floor illumination at the

receptacle identified U2025 on the panel.

(d) Torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(4) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the quick-release pin.

(5) Secure the centre console aft left-hand side panel in a manner similar to that described for the right-hand panel, the electrical plug is identified U2026.

(6) Secure the centre console forward panels and torque tighten the panel screws to between 40 and 45 lbf in (0.44 and 0.51 mdaN).

(7) If necessary, replace the co-pilot's seat (Ref. 25-11-21, Removal/Installation).

(8) Remove the safety clips and reset the circuit breakers previously tripped.

(9) Remove the locking pins from the droop nose.

(10) Carry out a freedom of movement and mechanical output test on the throttle system (Ref. 76-11-00, Adjustment/Test).

REHEAT/CONTINGENCY SWITCH - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

The reheat/contingency switches are situated at the rear of the throttle gate in the pilots' centre console panel 9-211. The switches are accessible for removal with the rear crate hinged back, but the switch actuating assembly may be removed with the crate closed.

2. RHT/CTY Switch

A. Equipment & Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Insertion/extraction tool	-
Torq-set screwdriver	-
Loctite	-
Thin-walled tubular spanner	-

B. Prepare

(1) Isolate the listed circuit breakers and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENG 1			
REHEAT AMP SUP	14-215	1K1541	C12
REHEAT CONT	15-216	1K1542	E 9
ENG 2			
REHEAT AMP SUP	13-215	2K1541	B14
REHEAT CONT	15-215	2K1542	D15
ENG 3			

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R REHEAT AMP SUP	13-216	3K1541	B 7
R REHEAT CONT	15-215	3K1542	D16
R			
R ENG 4			
R REHEAT AMP SUP	15-216	4K1541	D 7
R REHEAT CONT	15-216	4K1542	E10
R			

(2) Fit the droop nose locking pins, remove the emergency lever, remove the centre console side panels and hinge back the crate (Ref. 76-11-12, Removal/Installation).

C. Remove Switch (Ref. Fig. 401)

CAUTION: ELECTROLUMINESCENT (EL) PANELS ARE SUSCEPTIBLE TO SCRATCHES AND CRACKS. ENSURE THAT TOOLS DO NOT DAMAGE THE POLISHED WALLS OF THE PANELS.

(1) From outside the crate, remove the screws securing the RHT/CTY switch actuating assembly; remove the assembly.

(2) Pull away the toggle switch extensions.

(3) From inside the crate, remove the plastic loom tie securing the rubber flap to the cable loom clamp.

(4) Remove, if necessary, the top cover securing the switch cable looms. Also remove cable ties, as required.

(5) Using the insertion/extraction tool remove the pin inserts from the in-line connectors and remove the electroluminescent panel (Ref. 33-16-00).

(6) Disconnect the electrical leads, using the insertion/extraction tool, from the rear of the switch.

(7) Remove the hexagonal nut securing the switch; remove the switch from inside the crate. Retain the locating and shake proof washers.

NOTE: If a new switch is to be fitted, the leads should, where practicable, be removed from the

old switch and connected to the new switch, one at a time.

CAUTION: DO NOT REMOVE THE BONDED SHIM, IF FITTED, SECURED TO THE REAR OF THE CRATE FRAME.

D. Install (Ref. Fig. 401)

(1) Comply with the electrical safety precautions.

(2) Insert the switch from inside the crate, position the locating washer on the switch and ensure that the lug on the washer engages the hole in the crate. Secure the switch with a shake proof washer and nut.

(3) Connect the cables to the switch using the insertion/ extraction tool on the pin inserts, in accordance with Wiring Diagram Manual 20-42-18 and the cable identification.

(4) Position the EL panel on the outside of the crate (Ref. 33-16-00) and using the insertion tool secure the pin inserts in the in-line connectors, in accordance with Wiring Diagram Manual 20-42-18 and the cable identification. Support the EL panel in position.

(5) Replace, if necessary, any cable loom ties removed, also the top cover, if removed; secure the screws with loctite.

(6) Replace the plastic loom tie securing the rubber flap to the cable loom clamp.

(7) Engage the switch actuating mechanism with the crate and secure it and the EL panel in position using screws.

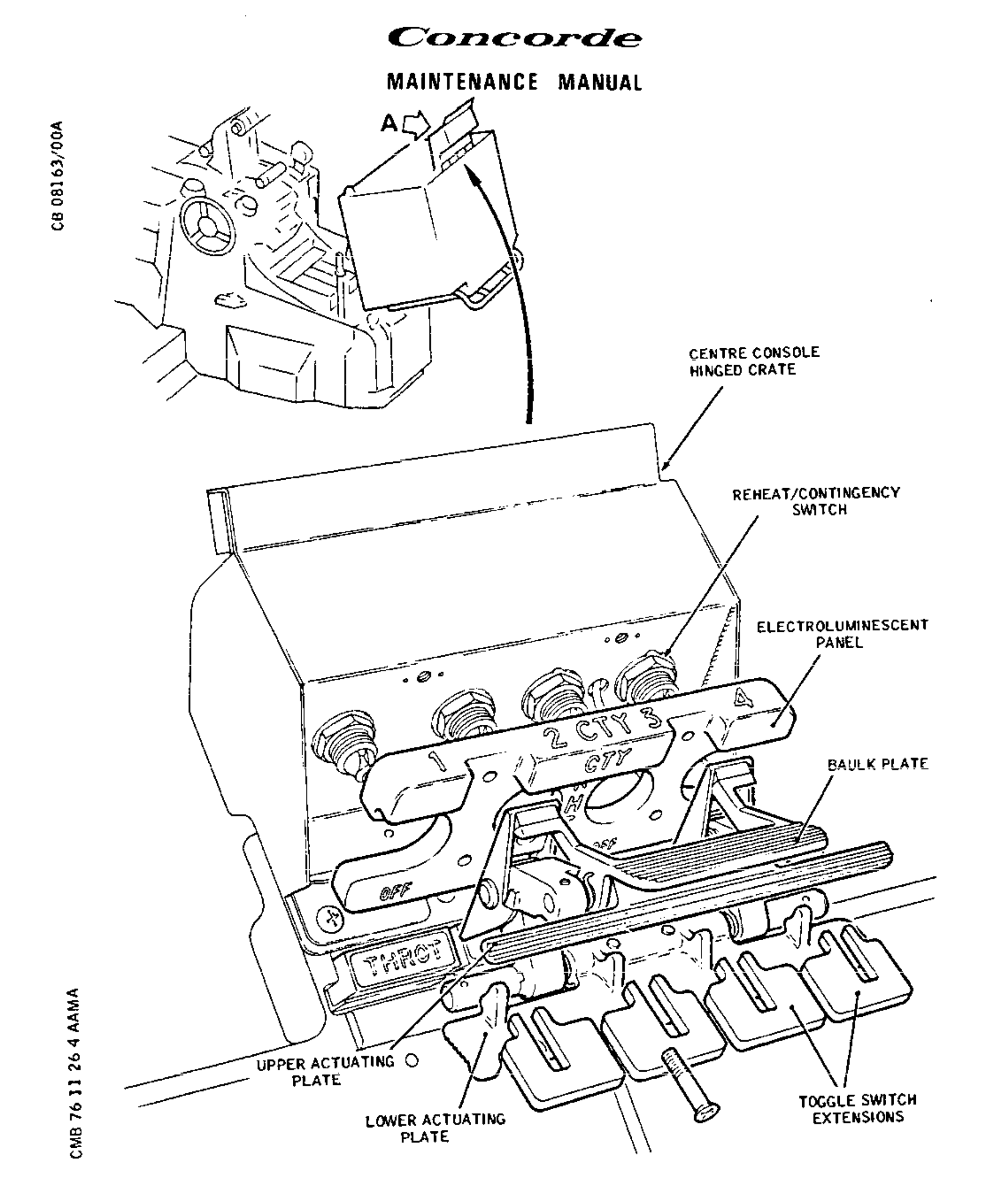
(8) Replace the switch toggle extensions.

(9) Carry out a mechanical test on the switch actuating assembly (Ref. para 3).

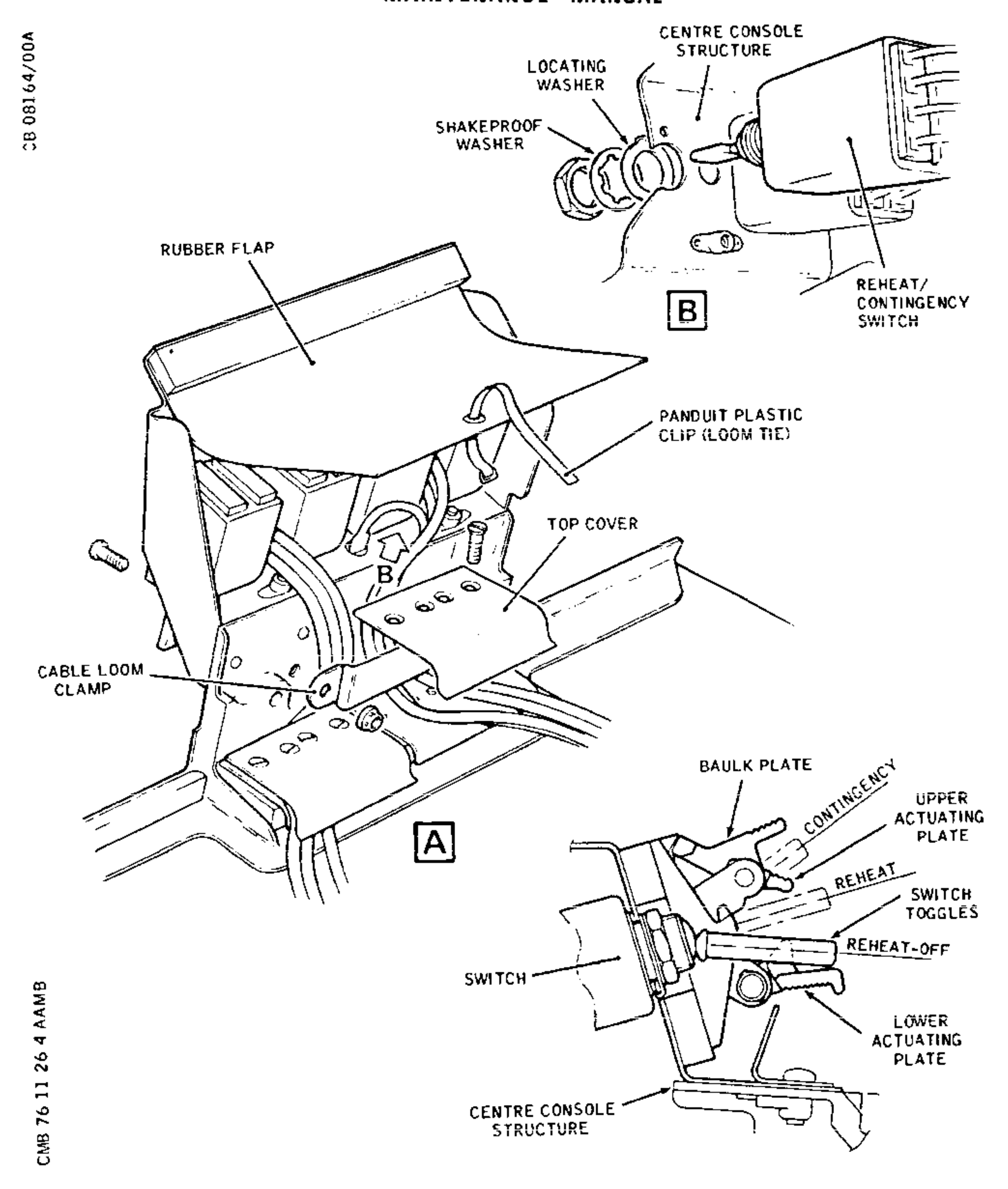
(10) Check that the area is clean, and that any cable looms disturbed have been replaced.

E. Conclusion

(1) Hinge forward the crate, replace the centre console side panels, the emergency lever and remove the locking pins from the droop nose (Ref. 76-11-12, Removal/Installation).



Reheat/Contingency Switch, Removal (Sheet 1 of 2)
Figure 401



Reheat Contingency Switch,Removal (Sheet 2 of 2)
Figure 401

(2) Remove the safety clips and reset the circuit breakers previously tripped.

(3) Carry out an electrical test on the reheat/contingency switches, (Ref. 76-11-26, Adjustment/Test).

3. Mechanical Check On Switch Actuating Mechanism (Ref. Fig. 401)

(1) With Nos. 1, 2, 3 and 4 RHT/CTY switches at OFF, set all four switches simultaneously to "RHT" (Reheat) using the lower actuating plate; check visually that Nos. 1, 2, 3 and 4 switches are at RHT.

(2) With Nos. 1, 2, 3 and 4 switches at RHT, set all four switches simultaneously to "CTY" (Contingency) by depressing the baulk plate and using the lower actuating plate; check visually that Nos. 1, 2, 3 and 4 switches are at CTY.

(3) With Nos. 1, 2, 3 and 4 switches at CTY set all four switches simultaneously to "RHT" by using the upper actuating plate; check visually that Nos. 1, 2, 3 and 4 are at RHT and that the baulk plate is locked.

(4) With Nos. 1, 2, 3 and 4 switches at RHT, set all four switches singly to "OFF" by using the switch toggles. Do not use the upper actuating plate.

NOTE: For operations 5, 6, 7 and 8 the baulk plate must be in the locked position.

(5) With Nos. 2, 3 and 4 switches at RHT and No 1 switch at OFF, set No 1 switch to "RHT" by using the lower actuating plate, switches Nos 2, 3 and 4 must remain at RHT.

(6) With Nos 1, 3 and 4 switches at RHT and No 2 switch at OFF, set No 2 switch to "RHT" by using the lower actuating plate, Switches Nos 1, 3 and 4 must remain at RHT.

(7) With Nos 1, 2 and 4 switches at RHT and No 3 switch at OFF, set No 3 switch to "RHT" by using the lower actuating plate. Switches Nos 1, 2 and 4 must remain at RHT.

(8) With Nos 1, 2 and 3 switches at RHT and No 4 switch at OFF, set No 4 switch to "RHT" by using the lower actuating plate. Switches Nos 1, 2 and 3 must remain at RHT.

(9) With none of the switches at CTY, move the upper actuating plate from CTY to RHT; the baulk plate must lock automatically.

NOTE: If an actuating assembly fails to pass one or more of these checks the assembly and switches are to be inspected for correct installation, distortion or damage and where necessary renewed.

ENGINE RPM PROBES - DESCRIPTION AND OPERATION

1. General

The probes are used to sense the rotational speeds of the LP and HP compressor shafts and produce electrical signals at a frequency proportional to the speed.

2. LP Compressor Probe (Ref. Fig. 001)

The LP compressor probe is attached to the front face of the pulse probe drive and housing by eight bolts. An assembly pin ensures the correct position of the unit on installation and a metallic sealing ring prevents oil leakage.

The probe consists of a stainless steel housing with a mounting flange, and a pole face, incoporating three pole pieces at the front end.

When mounted on the engine, the pole face is in close proximity to the periphery of the pulse probe toothed wheel.

The housing encloses a bar magnet and seven sensing coils adjacent to the pole face. An hermetically sealed electrical connector, mounted at the rear of the housing, provides for connection of the electrical harness lead.

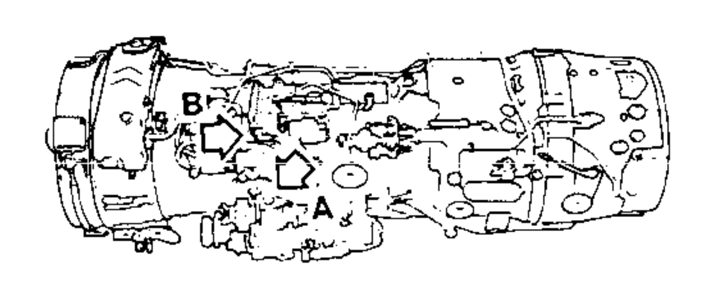
The permanent magnet within the unit produces a magnetic field around the seven sensing coils that provide corresponding signal outputs for use as shown.(Ref. Fig. 002). As the pulse probe wheel teeth pass the pole face, the flux density through each pole piece is changed, the maximum flux density occurring when teeth and pole pieces are aligned. E.m.f.'s induced in the sensing coils by the changes in flux density is maximum amplitude when the rate of change of flux density is greatest. The frequency of the induced e.m.f.'s is proportional to the shaft speed.

3. HP Compressor Probe (Ref. Fig. 001)

The HP compressor probe is attached by eight bolts to to the base of the LH gearbox (Ref. Fig. 001), and is located and sealed in the same manner as the LP probe.

The probe consists of a housing with a mounting flange, and a pole face, incoporating two pole pieces, at the front end. When mounted on the engine, the pole face is in close proximity to the periphery of the idler gear in the gearbox. The housing encloses a bar magnet and five sensing coils adjacent to the pole face. The rear of the housing accommodates an hermetically sealed electrical connector

CR 31302/00A



COMPRESSOR INTERMEDIATE CASE

COMPRESSOR LP PROBE

PULSE PROBE TOOTHED WHEEL

PROBE DRIVE AND HOUSING

A

PULSE PROBE TOOTHED WHEEL

LH GEARBOX

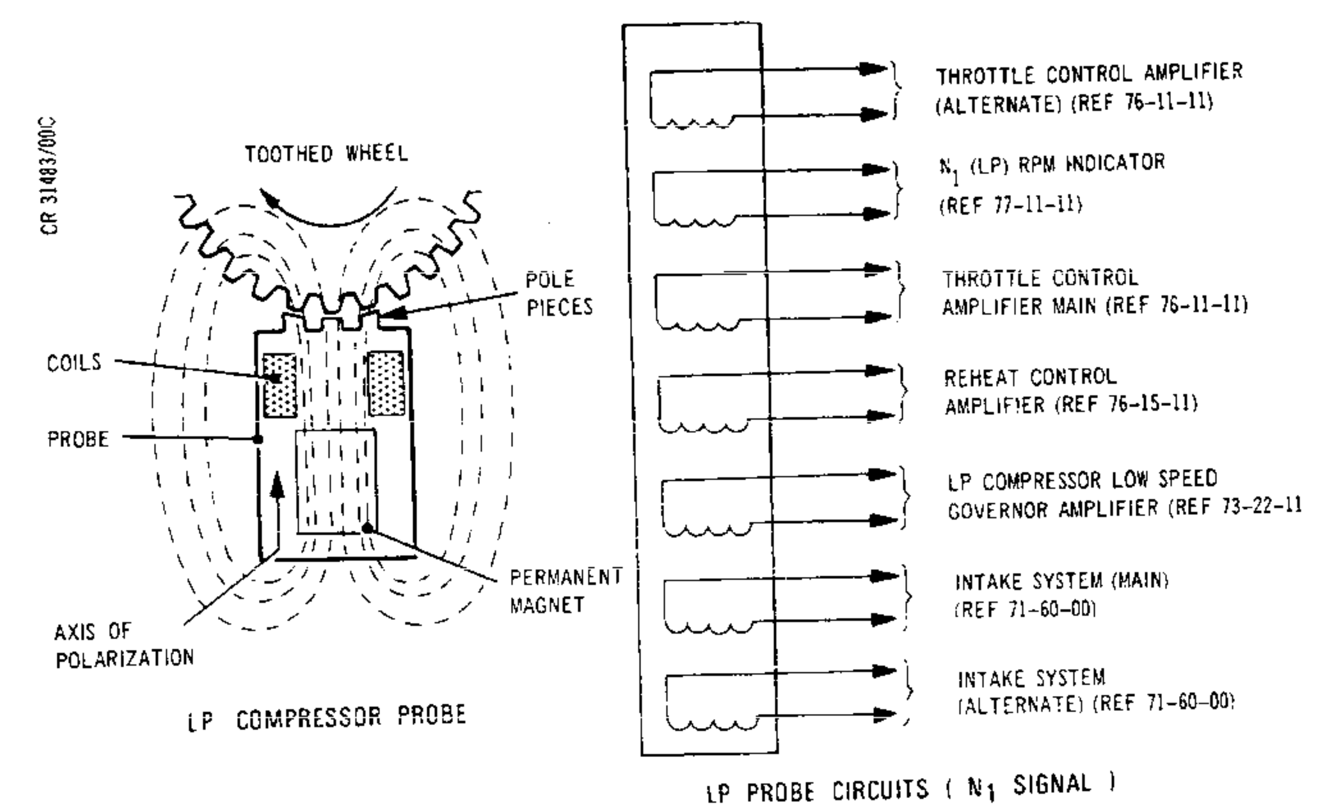
POLE PIECES

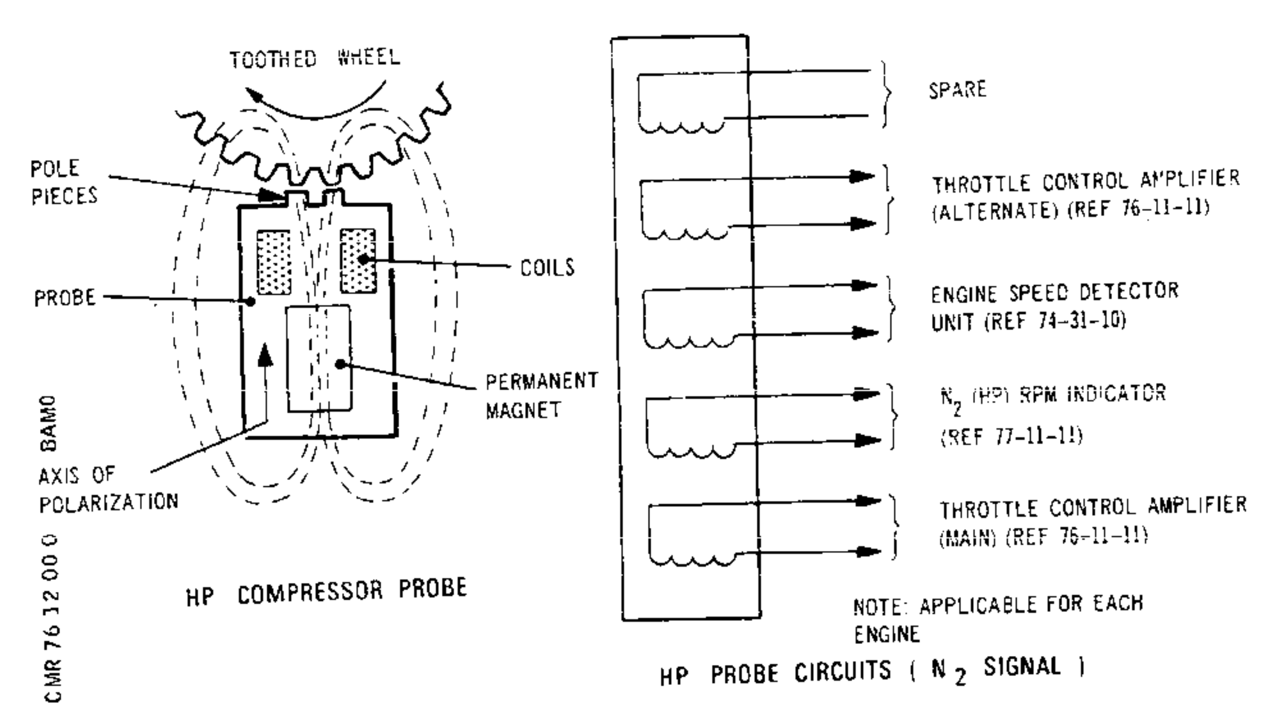
HP COMPRESSOR PROBE

B

CMR 76 12 00 0 AAM0

Engine RPM Probes
Figure 001





Circuits Served by Probes
Figure 002

R

mounted at 90 degrees to the axis of the probe for the connection of the electrical harness lead.

The permanent magnet within the unit produces a magnetic field around the five sensing coils that provide five corresponding signal outputs for use as shown (Ref. Fig. 002). As the idler gear teeth pass the pole face, the flux density through each pole piece is changed, the maximum flux density occurring when gear teeth and pole pieces are aligned. E.m.f.'s induced in the sensing coils by the changes in flux density reach maximum amplitude when the rate of change of flux density is greatest. The frequency of the induced e.m.f.'s is proportional to the shaft speed.

LP COMPRESSOR RPM PROBE - REMOVAL/INSTALLATION

1. RPM Probe (Ref. Fig. 401)

   A. Prepare to Remove Probe.

      (1) Open engine bay front lower door (Ref.71-00-00, Servicing).

   B. Remove Probe.

      (1) Disconnect electrical lead from probe. Use clean, dry blanks and immediately blank the probe receptacle and lead end plug.

      (2) Remove bolts securing probe to pulse probe drive and housing and withdraw probe together with gasket.

   C. Install Probe.

      (1) Apply lubricant A (Ref.70-00-01, Servicing and Storage Materials) to probe attachment bolts.

R CAUTION: IT IS OF THE UTMOST IMPORTANCE THAT THE
R THIN ALUMINIUM FOIL FACING, THAT IS A
R FEATURE OF THE SEAL, IS UNDAMAGED AND
R INTACT PRIOR TO FITTING. ON NO ACCOUNT
R MUST THIS FOIL BE REMOVED.

B NOTE: To assist in retaining Corruplus seal in
B position during fitment of probe, lightly
B smear the seal location groove on the
B pulse probe with Aeroshell 7 grease.

R (2) With a new sealing ring in position, assemble probe to housing with assembly pin aligned.

      (3) Secure probe with eight bolts torque-tightened to between 85 and 95 lbf in (9,6 and 10,7 Nm).

CAUTION: PROBE MAGNETISM CAN ATTRACT METALLIC PARTICLES AND EXTRANEOUS MATERIAL INTO PROBE RECEPTACLE, THIS CAN BRIDGE THE ELECTRICAL PINS AND CAUSE LOSS OF SIGNAL OR SIGNAL INTERFERENCE.

(4) Remove blank from probe receptacle and check for cleanliness.

(a) Check the wall of the receptacle and electrical pins for the presence of extraneous material using a X5 magnifying glass and a good light source.

(b) If contamination is present, remove it with a blast of clean, dry compressed air and/or the use of tweezers.

(c) Ensure the receptacle and electrical pins remain free of contamination and immediately connect electrical lead (Ref. para.(5)).

(5) Ensure that the lead end plug is equally as clean as the probe receptacle and immediately connect and tighten electrical lead.

D. Complete the Installation.

(1) Close engine bay front lower door (Ref.71-00-00, Servicing).

(2) With aircraft power supply available, carry out a check of the probe circuits (Ref.76-12-01, Adjustment/Test).

(b) If contamination is present, remove it with a blast of clean, dry compressed air and/or the use of tweezers.

(c) Ensure the receptacle and electrical pins remain free of contamination and immediately connect electrical lead (Ref. para.(5)).

(5) Ensure that the lead end plug is equally as clean as the probe receptacle and immediately connect and tighten electrical lead.

D. Complete the Installation

(1) Close engine bay front lower door (Ref. 71-00-00, Servicing).

RB (2) With aircraft power supply available, carry out a check of the probe circuits (Ref. 76-12-02, Adjustment/Test).

LP COMPRESSOR RPM PROBE - ADJUSTMENT/TEST

1. General

A check of the LP compressor rpm probe circuits is required to ensure that the lead end plug is connected and that all pin contacts are effective. Use of the throttle master switch and aircraft system will not disclose a faulty connection while an engine is static. A comprehensive check of the probe operating circuits will require a check of the N1 signal to the reheat system, the LP overspeed governor and the air intake control system in addition to the engine control and rpm indication systems check detailed in paragraph 3. A partial check can be made using the fault locating test set PE.35480 as detailed in 76-11-00, Adjustment/Test, paragraph 7. If test sets are not available, a functional check can be carried out at the next convenient engine run.

2. Tools and Equipment

Test Set (with three cables)	QT6A15/24 or QT6A15/24A
Circuit breaker safety clip	-

3. Test of LP Compressor RPM Probe of Engine Control System

NOTE: Confidence checks are to be carried out when it is necessary to confirm the serviceability of the test set (Ref.76-11-00, Adjustment/Test).

NOTE: Illumination of the DS lamp during the check procedure, other than for the lamp operation tests, indicates a distorted power supply which can give unreliable results. No checks or adjustments, other than fault interrogation and the safety system check, are to be carried out until the fault is rectified.

A. Basic Procedure for Test.

(1) Electrically isolate the engine services for the engine upon which tests are to be carried out by tripping the circuit breakers given in Table 501. Attach safety clips.

WARNING: WHENEVER ENGINE HP CONTROL CIRCUIT BREAKER IS TO BE TRIPPED OR HP VALVE SWITCH IS SET TO OPEN, FIRST TRIP ASSOCIATED T1 PROBE HEATER CIRCUIT BREAKER AND PREVENT UN-NECESSARY HEATER OPERATION. HEATER(S)

WOULD BE SWITCHED ON AND ATTAIN OPERATING TEMPERATURE WITHIN 30 SECONDS OF HP VALVE SWITCH OR CIRCUIT BREAKER OPERATION.

SERVICE	PANEL	CIRCUITBREAKER	MAPREF.
Engine No.1			
MAIN THROT SUP	2-213	1K1	F12
MAIN THROT CONT	3-213	1K3	A1
MAIN THROT SUP	14-215	1K2	G12
ALTN THROT CONT	15-216	1K4	E8
AICU 1A SUP	2-213	1K2050	D14
AICU 1B SUP	14-216	1K2051	A5
T1 PROBE HTR SUP	13-215	1H542	C9
RH IGNITION SUP	1-213	1J4	N5
LH IGNITION SUP	2-213	1J3	E12
REHEAT IGNITION SUP PH A	14-215	1K1543	B13
REHEAT IGNITION SUP PH C	14-215	1K1544	F12
START FUEL PUMP SUP	1-213	1Q812	J6
RH UC WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH UC WEIGHT SW 'B' SYS SUP	3-213	G293	B8
HP VALVE CONT	3-213	1K131	C1

Circuit Breakers
Table 501 (Continued)

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
Engine No.2			
MAIN THROT SUP	2-213	2K1	C12
MAIN THROT CONT	1-213	2K3	A3
ALTN THROT SUP	13-215	2K2	F14
ALTN THROT CONT	15-215	2K4	F15
AICU 2A SUP	13-216	2K2050	A3
AICU 2B SUP	2-213	2K2051	H14
T1 PROBE HTR SUP	14-215	2H542	E8
RH IGNITION SUP	1-213	2J4	P5
LH IGNITION SUP	2-213	2J3	B10
REHEAT IGNITION SUP PH A	13-215	2K1543	A14
REHEAT IGNITION SUP			

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
PH C	13-215	2K1544	E14
START FUEL PUMP SUP	1-213	2Q812	K6
RH US WEIGHT SW 'A'			
SYS SUP	1-213	G295	M18
LH US WEIGHT SW 'B'			
SYS SUP	3-213	G293	B8
HP VALVE CONT	1-213	2K131	C3
<u>Engine No.3</u>			
MAIN THROT SUP	2-213	3K1	C13
MAIN THROT CONT	1-213	3K3	A4
ALTN THROT SUP	13-216	3K2	A7
ALTN THROT CONT	15-215	3K4	F16
AICU 3A SUP	2-213	3K2050	H13
AICU 3B SUP	13-216	3K2051	B3
T1 PROBE HTR SUP	14-216	3H542	C14
RH IGNITION SUP	1-213	3J4	Q5
LH IGNITION SUP	2-213	3J3	B11
REHEAT IGNITION SUP			
PH A	13-216	3K1543	A5
REHEAT IGNITION SUP			
PH C	13-216	3K1544	F6
START FUEL PUMP SUP	1-213	3Q812	L6
RH UC WEIGHT SW 'A'			
SYS SUP	1-213	G295	M18
LH UC WEIGHT SW 'B'			
SYS SUP	3-213	G293	B8
HP VALVE CONT	1-213	3K131	C4

Circuit Breakers
Table 501 (Continued)

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
<u>Engine No.4</u>			
MAIN THROT SUP	2-213	4K1	F13
MAIN THROT CONT	3-213	4K3	A2
ALTN THROT SUP	14-216	4K2	C7
ALTN THROT CONT	15-216	4K4	F11
AICU 4A SUP	14-216	4K2050	B5
AICU 4B SUP	2-213	4K2051	B14
T1 PROBE HTR SUP	13-216	4H542	C11
RH IGNITION SUP	1-213	4J4	R5

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
LH IGNITION SUP	2-213	4J3	E13
REHEAT IGNITION SUP PH A	14-216	4K1543	A6
REHEAT IGNITION SUP PH C	14-216	4K1544	E7
START FUEL PUMP SUP	1-213	4Q812	M6
RH US WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH US WEIGHT SW 'B' SYS SUP	3-213	G293	B8
HP VALVE CONT	3-213	4K131	C2

Circuit Breakers
Table 501 (Concluded)

CAUTION: DO NOT CONNECT TEST SET TYPE QT6A15/24 TO AMPLIFIER TYPE A6A16/24CA.

(2) Remove relevant plug and socket covers from MAIN engine control amplifier and connect cable 2 between the test set plug PL2 and the amplifier socket SK2.

B. Test the Engine/Probe Circuits.

(1) Make the following flight compartment switch selections.

ENG FLIGHT RATING	-	CLIMB
ENG RATING MODE	-	TAKE OFF
NORMAL ENGINE CONTROL SCHEDULE	-	LO
Ignition selector	-	OFF
AUTO IGNITION	-	OFF
Pilots throttle lever	-	IDLE
GRD IDLE	-	HI
THROTTLE MASTER	-	OFF
RELIGHT/START	-	OFF
ENG 4 T/O N1 LIM	-	NORM

(2) Make the following test set switch selections.

SW 1	-	position 1
SW 2	-	position 1
SW 3	-	SIM
All other		

switches - up

(3) Set the engine control system circuit breakers (Ref. Table 502).

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
Engine No.1			
MAIN THROT SUP	2-213	1K1	F12
MAIN THROT CONT	3-213	1K3	A1
ALTN THROT SUP	14-215	1K2	G12
ALTN THROT CONT	15-216	1K4	E8
Engine No. 2			
MAIN THROT SUP	2-213	2K1	C12
MAIN THROT CONT	1-213	2K3	A3
ALTN THROT SUP	13-215	2K2	F14
ALTN THROT CONT	15-215	2K4	F15

Circuit Breakers
Table 502 (Continued)

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
Engine No.3			
MAIN THROT SUP	2-213	3K1	C13
MAIN THROT CONT	1-213	3K3	A4
ALTN THROT SUP	13-216	3K2	A7
ALTN THROT CONT	15-215	3K4	F16
Engine No.4			
MAIN THROT SUP	2-213	4K1	F13
MAIN THROT CONT	3-213	4K3	A2
ALTN THROT SUP	14-216	4K2	C7
ALTN THROT CONT	15-216	4K4	F11

Circuit Breakers
Table 502 (Concluded)

(4) Check that the green GO lamp is illuminated and position indicator shows position 30. If necessary, advance indicator to position 30 by pressing GO button.

(5) Select MASTER THROTTLE switch to MAIN and check that:

(a) The throttle failure warning light remains out.

(b) The flight compartment N1 rpm indicator reads between 35 and 50%.

(6) Select MASTER THROTTLE switch to OFF and trip the engine control circuit breakers (Ref. Table 502).

(7) Disconnect the test cable from the main amplifier socket and install the socket cover. Remove the cover from socket (SK2) on the alternative amplifier and connect the test cable.

(8) Set the engine control circuit breakers (Ref. Table 502), select MASTER THROTTLE switch to ALTERNATE and repeat the check of paragraph (5)(a) and (b).

(9) Select MASTER THROTTLE switch to OFF, trip engine control circuit breakers (Ref.Table 502) and attach safety clips.

(10) Check the LP overspeed governor as detailed for the probe circuit in 73-22-00, Adjustment/Test. Check the probe circuits for the reheat system (Ref. 73-23-03, Adjustment/Test) and for the air intake system (Ref.71-61-00, Adjustment/Test).

(11) On satisfactory completion of check, return flight compartment and test set switches to their original settings (Ref.para.(1) and (2)).

C. Complete the Test Procedure.

(1) Disconnect and remove the test cable and replace plug and socket covers.

(2) Remove safety clips and reset the circuit breakers (Ref. Table 501).

HP COMPRESSOR RPM PROBE - REMOVAL/INSTALLATION

1. PRM Probe (Ref. Fig.401)

   A. Prepare to Remove Probe.

      (1) Open engine bay front lower door (Ref.71-00-00, Servicing).

   B. Remove Probe.

      (1) Disconnect electrical lead from probe. Use clean dry blanks and immediately blank the probe receptacle and lead end plug.

      (2) Place clean container (at least one litre) beneath probe to collect oil drainage.

      (3) Remove probe securing bolts and withdraw probe together with gasket. Measure and record quantity of oil drained.

   C. Install Probe.

      (1) Apply lubricant A (Ref. 70-00-01, Servicing and Storage Materials) to probe securing bolts.

R B NOTE: To assist in retaining Corruplus seal in
R B position during fitment of probe, lightly
R B smear the seal location groove on the
R B pulse probe with Aeroshell 7 grease.

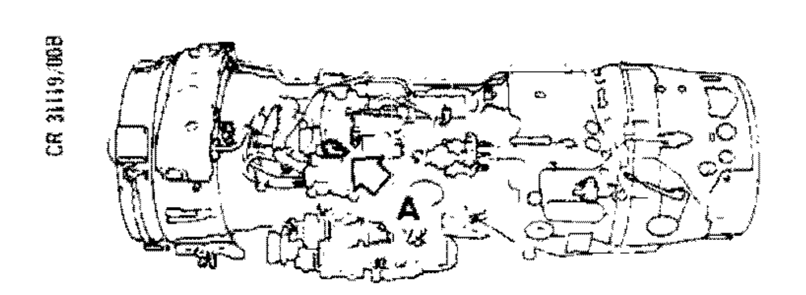
      (2) With a new gasket in position, place probe in position with electrical connection facing rearwards and engage assembly pin with hole in gearbox flange.

      (3) Secure probe with eight bolts torque-tightened to between 67 and 73 lbf in. (7,6 and 8,2 N.m).

         CAUTION: PROBE MAGNETISM CAN ATTRACT METALLIC PARTICLES AND EXTRANEOUS MATERIAL INTO PROBE RECEPTACLE, THIS CAN BRIDGE THE ELECTRICAL PINS AND CAUSE LOSS OF SIGNAL OR SIGNAL INTERFERENCE.

      (4) Remove blank from probe receptacle and check for cleanliness.

         (a) Check the well of the receptacle and electrical pins for the presence of extraneous material using a X5 magnifying glass and a good light source.



LEFT-HAND GEARBOX

ASSEMBLY PIN LOCATION

GASKET

OIL PUMP

A

CMR76 12 02 4 AAM0

RPM Probe and Location Detail
Figure 401

(b) If contamination is present, remove it with a blast of clean, dry compressed air and/or the use of tweezers.

(c) Ensure the receptacle and electrical pins remain free from contamination and immediately connect electrical lead (Ref. para.(5)).

(5) Ensure that the lead end plug is equally as clean as the probe receptacle and immediately connect and tighten electrical lead.

(6) With the oil tank full (Ref. 12-13-79) and the overflow drain connection drain plug installed, add a quantity of oil to the tank equivalent to the amount drained during the removal procedure.

D. Complete the Installation.

(1) Close engine bay front lower door (Ref. 71-00-00, Servicing).

(2) With aircraft power supply available, carry out a check of the probe circuits (Ref.76-12-01, Adjustment/Test).

HP COMPRESSOR RPM PROBE - ADJUSTMENT/TEST

1. General

A check of the HP compressor rpm probe circuits is required to ensure that the lead end plug is connected and that all pin contacts are effective. Use of the throttle master switch and aircraft system will not disclose a faulty connection while an engine is static. A comprehensive check of the probe operating circuits will require a check of the N2 signal tothe engine speed unit, for the emergency ac generation and engine starting systems, in addition to the engine control and rpm indication systems check detailed in paragraph 3. A partial check can be made using the fault locating test set PE.35480 as detailed in 76-11-00, Adjustment/Test, Para. 7. If test sets are not available, a functional check can be carried out at the next convenient engine run.

2. Tools and Equipment

Test Set (with three cables)	QT6A15/24 or QT6A15/24A
Circuit breaker safety clip	-

3. Test of HP Compressor RPM Probe Part of Engine Control System

NOTE: Confidence checks are to be carried out when it is necessary to confirm the serviceability of the test set (Ref. 76-11-00, Adjustment/Test).

NOTE: Illumination of the DS lamp during the check procedure, other than for the lamp operation tests, indicates a distorted power supply which can give unreliable results. No checks or adjustments, other than fault interrogation and the safety system check, are to be carried out until the fault is rectified.

A. Basic Procedure for Test.

(1) Electrically isolate the engine services for the engine upon which tests are to be carried out by tripping the circuit breakers given in Table 501. Attach safety clips.

WARNING: WHENEVER ENGINE HP CONTROL CIRCUIT BREAKER IS TO BE TRIPPED OR HP VALVE SWITCH IS SET TO OPEN, FIRST TRIP ASSOCIATED T1 PROBE HEATER CIRCUIT BREAKER AND PREVENT UN-NECESSARY HEATER OPERATION. HEATER(S)

WOULD BE SWITCHED ON AND ATTAIN OPERATING TEMPERATURE WITHIN 30 SECONDS OF HP VALVE SWITCH OR CIRCUIT BREAKER OPERATION.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No. 1			
MAIN THROT SUP	2-213	1K1	F12
MAIN THROT CONT	3-213	1K3	A1
ALTN THROT SUP	14-215	1K2	G12
ALTN THROT CONT	15-216	1K4	E8
AICU 1A SUP	2-213	1K2050	D14
AICU 1B SUP	14-216	1K2051	A5
T1 PROBE HTR SUP	13-215	1H542	C9
RH IGNITION SUP	1-213	1JA	N5
LH IGNITION SUP	2-213	1JA	E12
REHEAT IGNITION SUP PH A	14-215	1K1543	B13
REHEAT IGNITION SUP PH C	14-215	1K1544	F12
START FUEL PUMP SUP	1-213	1Q812	J6
RH UC WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH UC WEIGHT SW 'B' SYS SUP	3-213	G293	B8
HP VALVE CONT	3-213	1K131	C1
Engine No. 2			
MAIN THROT SUP	2-213	2K1	C12
MAIN THROT CONT	1-213	2K3	A3
ALTN THROT SUP	13-215	2K2	F14
ALTN THROT CONT	15-215	2K4	F15
AICU 2A SUP	13-216	2K2050	A3
AICU 2B SUP	2-213	2K2051	H14
T1 PROBE HTR SUP	14-215	2H542	E8
RH IGNITION SUP	1-213	2J4	P5
LH IGNITION SUP	2-213	2J3	B10
REHEAT IGNITION SUP PH A	13-215	2K1543	A14
REHEAT IGNITION SUP PH C	13-215	2K1544	E14
START FUEL PUMP SUP	1-213	2Q812	K6
RH UC WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH UC WEIGHT SW 'B' SYS SUP	3-213	G293	B8

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
HP VALVE CONT	1-213	2K131	C3
Engine No. 3			
MAIN THROT SUP	2-213	3K1	C13
MAIN THROT CONT	1-213	3K3	A4
ALTN THROT SUP	13-216	3K2	A7
ALTN THROT CONT	15-215	3K4	F16
AICU 3A SUP	2-213	3K2050	H13
AICU 3B SUP	13-216	3K2051	B3
T1 PROBE HTR SUP	14-216	3H542	C14
RH IGNITION SUP	1-213	3J4	Q5
LH IGNITION SUP	2-213	3J3	B11
REHEAT IGNITION SUP PH A	13-216	3K1543	A5
REHEAT IGNITION SUP PH C	13-216	3K1544	F6
START FUEL PUMP SUP	1-213	3Q812	L6
RH UC WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH UC WEIGHT SW 'B' SYS SUP	3-213	G293	B8
HP VALVE CONT	1-213	3K131	C4
Engine No. 4			
MAIN THROT SUP	2-213	4K1	F13
MAIN THROT CONT	3-213	4K3	A2
ALTN THROT SUP	14-216	4K2	C7
ALTN THROT CONT	15-216	4K4	F11
AICU 4A SUP	14-216	4K2050	B5
AICU 4B SUP	2-213	4K2051	B14
T1 PROBE HTR SUP	13-216	4H542	C11
RH IGNITION SUP	1-213	4J4	R5
LH IGNITION SUP	2-213	4J3	E13
REHEAT IGNITION SUP PH A	14-216	4K1543	A6
REHEAT IGNITION SUP PH C	14-216	4K1544	E7
START FUEL PUMP SUP	1-213	4Q812	M6
RH US WEIGHT SW 'A' SYS SUP	1-213	G295	M18
LH US WEIGHT SW 'B' SYS SUP	3-213	G293	B8

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
HP VALVE CONT	3-213	4K131	C2

Circuit Breakers
Table 501 (Concluded)

CAUTION: DO NOT CONNECT TEST SET TYPE QT6A15/24 TO AMPLIFIER TYPE A6A16/24CA.

(2) Remove relevant plug and socket covers from MAIN engine control amplifier and connect cable 2 between the test set plug PL2 and the amplifier socket SK2.

B. Test the Engine/Probe Circuits.

(1) Make the following flight compartment switch selections.

ENG FLIGHT RATING	- CLIMB
ENG RATING MODE	- TAKE OFF
NORMAL ENGINE CONTROL SCHEDULE	- LO
Ignition selector	- OFF
AUTO IGNITION	- OFF
Pilots throttle lever	- IDLE
GRD IDLE	- HI
THROTTLE MASTER	- OFF
RELIGHT/START	- OFF
ENG 4 T/O N1 LIM	- NORM

(2) Make the following test set switch selections.

SW 1	- position 1
SW 2	- position 1
SW 3	- SIM
All other switches	- up

(3) Set the engine control system circuit breakers (Ref. Table 502).

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No. 1			
MAIN THROT SUP	2-213	1K1	F12
MAIN THROT CONT	3-213	1K3	A1
ALTN THROT SUP	14-215	1K2	G12
ALTN THROT CONT	15-216	1K4	E8
Engine No. 2			
MAIN THROT SUP	2-213	2K1	C12
MAIN THROT CONT	1-213	2K3	A3
ALTN THROT SUP	13-215	2K2	F14
ALTN THROT CONT	15-215	2K4	F15
Engine No. 3			
MAIN THROT SUP	2-213	3K1	C13
MAIN THROT CONT	1-213	3K3	A4
ALTN THROT SUP	13-216	3K2	A7
ALTN THROT CONT	15-215	3K4	F16
Engine No. 4			
MAIN THROT SUP	2-213	4K1	F13
MAIN THROT CONT	3-213	4K3	A2
ALTN THROT SUP	14-216	4K2	C7
ALTN THROT CONT	15-216	4K4	F11

Circuit Breakers
Table 502 (Concluded)

(4) Check that the green GO lamp is illuminated and position indicator shows position 30. If necessary, advance indicator to position 30 by pressing GO button.

(5) Select MASTER THROTTLE switch to MAIN and check that:

(a) The throttle failure warning light remains out.

(b) The flight compartment N2 rpm indicator reads between 50 and 70%.

(6) Select MASTER THROTTLE switch to OFF and trip the

engine control circuit breakers (Ref. Table 502).

(7) Disconnect the test cable from the main amplifier socket and install the socket cover. Remove the cover from socket (SK2) on the alternative amplifier and connect the test cable.

(8) Set the engine control circuit breakers (Ref. Table 502), select MASTER THROTTLE switch to ALTERN and repeat the check of paragraph (5)(a) and (b).

(9) Select MASTER THROTTLE switch to OFF, trip engine control circuit breakers (Ref.Table 502) and attach safety clips.

(10) Check the probe circuit to the engine speed unit using the relevant part of the adjustment/test procedure given in 24-22-22.

(11) On satisfactory completion of check, return flight compartment and test set switches to their original settings (Ref.para. (1) and (2)).

C. Complete the Test Procedure.

(1) Disconnect and remove the test cable and replace plug and socket covers.

(2) Remove safety clips and reset the circuit breakers (Ref. Table 501).

END OF THIS SECTION

NEXT

R PRIMARY NOZZLE CONTROL SIGNAL PITOT AND REHEAT PRESSURE
R DETECTOR CONNECTOR - REMOVAL/INSTALLATION

1. General

The pitot is located on the spherical joint flange and is installed on the left or right-hand side depending on the engine position in the nacelle. The alternative location is used for the installation of the reheat pressure detector connector.

Filters and a restrictor are retained in the pitot union by a circlip. The filters are withdrawn from the pitot union for inspection/check or renewal after pitot union removal from the engine (Ref.para.2.C.).

2. Signal Pitot (Ref.Fig.401)

A. Prepare to Remove Pitot.

(1) Remove engine (Ref.71-00-00, Removal/Installation).

B. Remove Pitot.

R (1) Remove wire-locking and unscrew tube union nut.

(2) Remove and discard the securing bolts, then remove the pitot union.

(3) Withdraw pitot from mounting on spherical joint flange.

C. Disassemble Pitot Union, Restrictor and Filters.

(1) Extract circlip and remove loose items from the pitot union in the sequence shown.

D. Examine Filters and Restrictor.

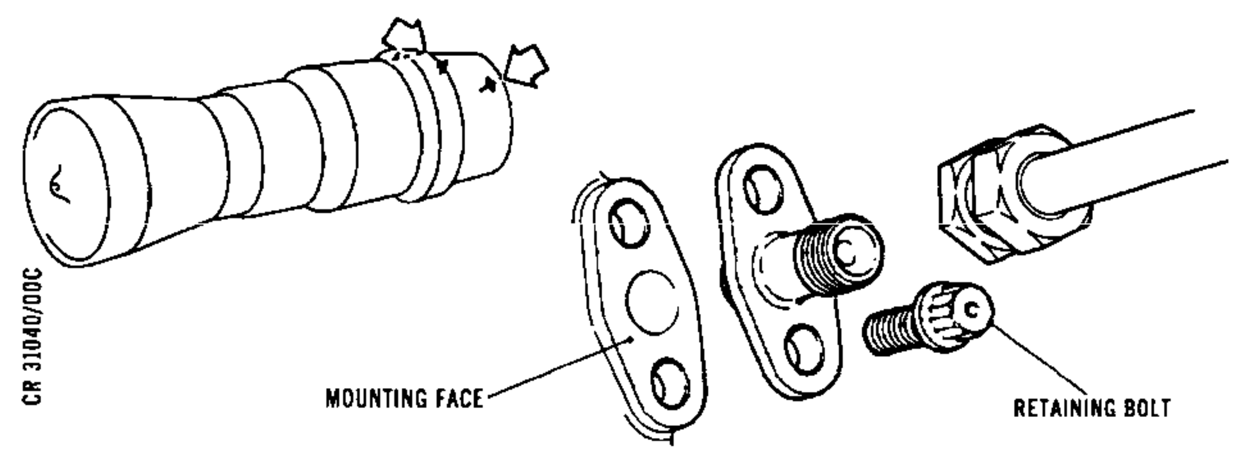
(1) Clean filters and examine for freedom from damage.

(2) Ensure that restrictor is free from obstruction.

(3) Renew any item proving unsatisfactory.

E. Assemble Pitot Union and Associated Loose Items.

(1) Insert spring and spring plate in pitot union.



PITOT UNION
SPRING
FILTERS
CIRCLIP
MOUNTING FACE
RETAINING BOLT
SPRING PLATE
RESTRICTOR
PITOT

PRIMARY NOZZLE CONTROL SIGNAL PITOT

TOP

SECTION THROUGH SPHERICAL JOINT FLANGE LOOKING FORWARD

THE POSITIONS OF THE SIGNAL PITOT AND REHEAT PRESSURE DETECTOR DEPENDS ON THE ENGINE POSITION IN THE NACELLE. THE POSITIONS COULD BE THE REVERSE OF THAT SHOWN.

Pitot and Reheat Pressure Detector Location Detail
Figure 401

(2) Place the restrictor between the two filters and insert the group in the pitot union against the spring plate.

(3) Verify that the assembly sequence has conformed to that shown in the illustration (Ref. Fig.401) and install the retaining circlip.

F. Install Pitot and Pitot Union Assembly.

R CAUTION: IT IS ESSENTIAL THAT LUBRICANT 'C' IS USED
R ON THE APPLICABLE BOLTS/NUTS DURING
R ASSEMBLY (REF. SB.OL.593-72-9044-436).

(1) Apply lubricant B (Ref.70-00-01, Servicing and Storage Materials) to the tube union connections and lubricant C to two new securing bolts.

(2) Position the pitot in its location with the assembly pin engaging the locating hole at the mating faces.

(3) Position union assembly on pitot and secure pitot and pitot union assembly with the two new bolts and torque-tighten to 100 lbf in (11,5 Nm).

(4) Screw on tube union nut and torque-tighten to between 190 and 210 lbf in (21,5 and 23,5 Nm).

(5) Wire-lock union nut and securing bolts together.

G. Complete the Installation.

(1) Install engine (Ref. 71-00-00, Removal/Installation).

3. Reheat Pressure Detector Connector (Ref. Fig.401)

A. Prepare to Remove Connector.

(1) Remove engine (Ref. 71-00-00, Removal/Installation).

B. Remove Connector.

(1) Remove wire-locking.

(2) Unscrew tube union nut.

(3) Remove and discard the securing bolts, then remove the connector.

R C. Install Connector.

R (1) Apply lubricant B (Ref.70-00-01, Servicing and Storage
R Materials) to the tube union connections and
R lubricant A to two new securing bolts (1/10A).

R (2) Position the connector on its location face and secure
R with the two new bolts. Torque-tighten to 100 lbf in.
R (11,5 N.m).

R (3) Screw on tube union nut and torque-tighten to between
R 190 and 210 lbf in. (21,5 and 23,5 N.m).

R (4) Wire-lock union nut and securing bolts together.

R D. Complete the Installation.

R (1) Install engine (Ref.71-00-00, Removal/Installation).

PRIMARY NOZZLE CONTROL (PNC) ASSEMBLY TRIM UNIT - DESCRIPTION AND OPERATION

1. General

The primary nozzle control assembly consists of the trim unit and a pneumatic valve that act together to control the primary nozzle area. The trim unit is described in this chapter and a description of the pneumatic valve is given in 76-13-12.

2. Description

The trim unit, shown in the illustration (Ref. Fig. 001), is an electrically driven gearbox that positions a tapered needle in an orifice to control the air reference pressure Pm that is effective in the PNC pneumatic valve. The needle position is under the command of the engine control amplifier.

A train of spur gears, shown in the illustration (Ref. Fig. 002), is carried on five main spindles supported by a gear housing and gearbox end plate. The gearbox is enclosed by a casing that forms an oil filled gear chamber and carries the seating guide assembly. The tapered needle in the seating guide is cam driven from the gear train.

Two a.c. motors, main and alternate, are mounted on the outer face of the gear housing with their drive shafts projecting through the housing and in engagement with separate drives. Both drives are transmitted via a differential gear and a clutch assembly. Each motor incorporates an electromagnetic brake. Two synchro transmitters are mounted on gear housing near to the motors. Each transmitter is geared to one of the motors. The motors and synchro transmitters are enclosed by a cover. The motor electrical connection receptacles protrude through sealed apertures in the cover which also incorporates a breather.

A housing sleeve retains the seating guide on the gearbox casing face and provides an inlet connection for the reference pressure air from the pneumatic valve. A restrictor is mounted on the outlet face of the housing sleeve and is positioned by an adjustment plate to locate the orifice to the tapered needle. A needle cover over the outlet provides the exhaust for the air spill past the orifice and incorporates a filter to prevent the ingress of dirt.

3. Operation

Operation of the trim unit is effected by the motor of the lane operative in engine control. When a change of trim is demanded, the control system powers the effective motor to

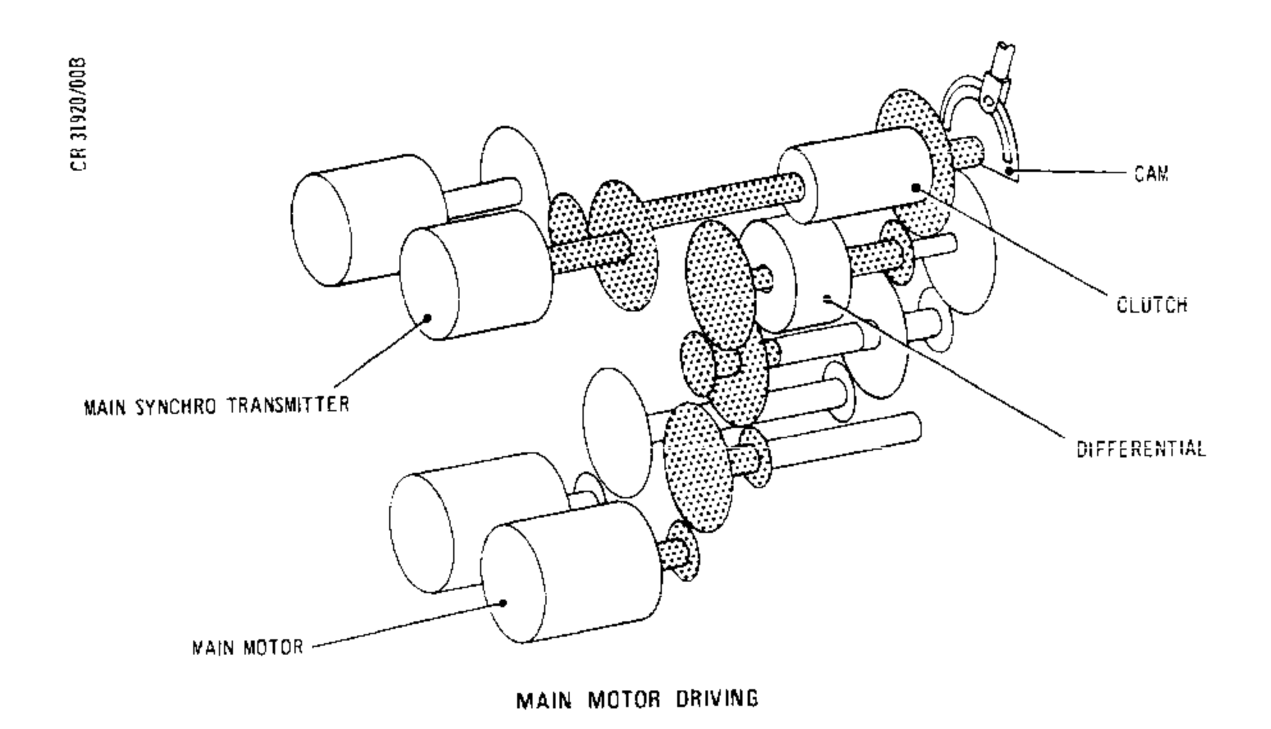
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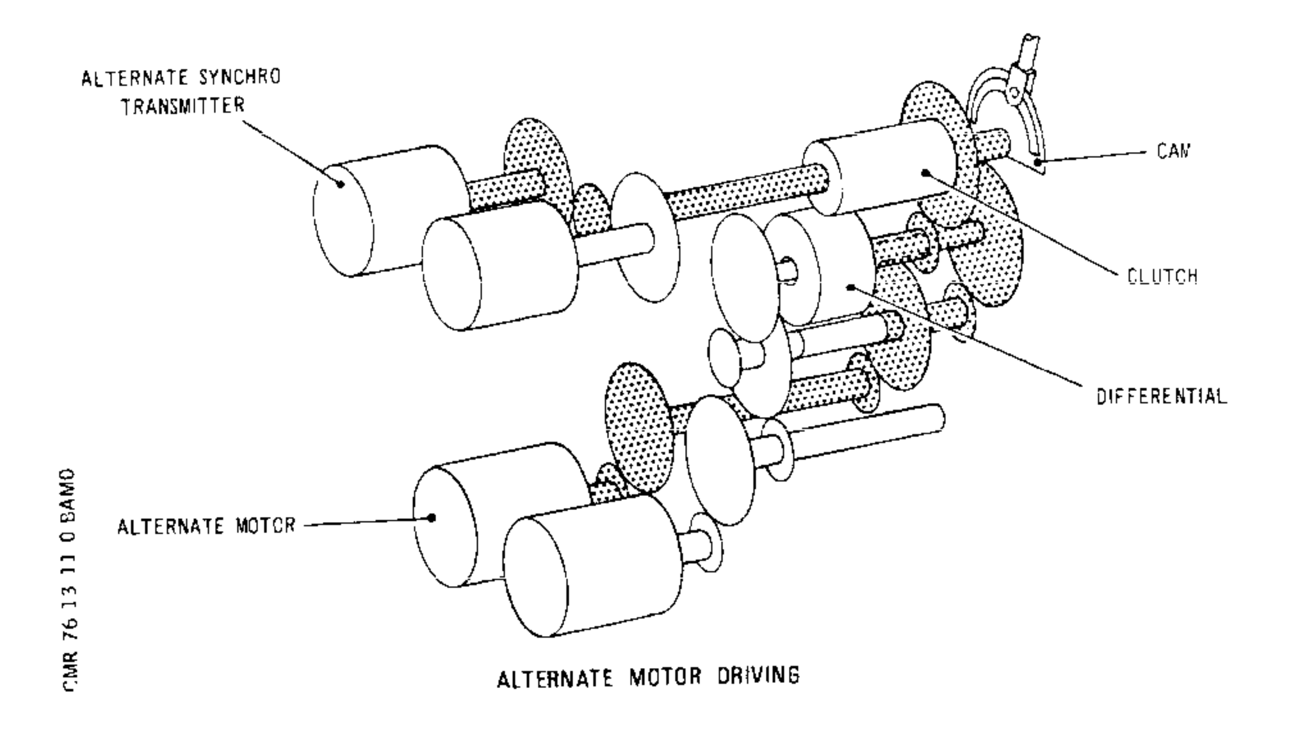
ORIFICE PLATE
HOUSING SLEEVE
SEATING GUIDE
NEEDLE
CAM

P3 AIR (SERVO) CONNECTION
COVER
CAM
BREATHER
COVER
CLUTCH
BREATHER
END PLATE
DIFFERENTIAL
ELECTRICAL CONNECTIONS
MOTORS
SYNCHRO TRANSMITTERS
GEAR HOUSING
CASING

CMR 76 13 11 0 AAM0

PNC Trim Unit
Figure 001





Gear Drive Schematic
Figure 002

drive the gearing. The non-effective motor is held stationary by the brake and the differential gear transmits the drive of the effective motor through the clutch to the cam which resets the needle position in the restrictor orifice. When the engine control demand is met the motor drive stops and the needle is held in a steady state setting.

The effective synchro transmitter and motor send a position feedback signal and a velocity feedback signal to the engine control amplifier in command. These sensing signals can result in modifying the command signal to the motor. The double driving gear of each transmitter is spring-loaded circumferentially to give gear contact in both directions and eliminate backlash.

Stops, at each end of the operating range, limit the cam operating range. Should the limit be reached with the motor still driving, the clutch setting would be exceeded and it would slip.

R PRIMARY NOZZLE CONTROL (PNC) ASSEMBLY TRIM UNIT - SERVICING

1. General

An oil change is required whenever a different brand of oil is to be used. Two oil level/filler plugs are provided one on each side of the trim unit, to facilitate access when the trim unit is installed in either position in the engine nacelle (Ref. Fig.301).

2. Tools and Equipment

Syringe	PE.35782
Tube	PE.35783

3. Oil Change Procedure

A. Prepare to Drain and refill Trim Unit

(1) Open engine bay rear lower door (Ref. 71-00-00, Servicing).

B. Drain Trim Unit

(1) Position a container of at least one litre capacity under the trim unit drain plug.

(2) Remove the drain plug and allow the oil to drain for 5 minutes. Discard the drained oil.

(3) Renew the seal washer, apply lubricant A (Ref. 70-00-01, Servicing and Storage Materials) and install the drain plug to its location. Torque-tighten the drain plug to between 120 and 130 lbf in (13.6 and 14.7 Nm).

C. Refill Trim Unit

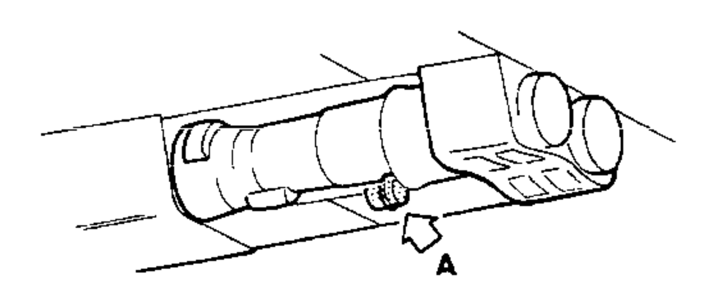
(1) Remove the level/filler plug.

(2) Use the syringe and tube and refill with approved oil through the level/filler plug location.

(3) Renew the seal washer, apply lubricant A (Ref. 70-00-01, Servicing and Storage Materials) and install level/filler plug to its location. Torque-tighten the drain plug to between 120 and 130 lbf in (13.6 and 14.7 Nm).

(4) Close the engine bay rear lower door (Ref. 71-00-00, Servicing).

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CMR 76 13 11 3 AAM0

Primary Nozzle Trim Unit
(Installation of Unit in No.1 and No.3 Nacelle)
Figure 301

R PRIMARY NOZZLE CONTROL (PNC) ASSEMBLY TRIM UNIT - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

A trim unit is part of the primary nozzle control (PNC) for each engine. The unit is secured to the bottom rear of the centrewall and access is gained by opening the engine bay doors.

The weight of a trim unit is approximately 25 lb (11.34 kg).

Where the PNC units are to be removed for jet pipe servicing refer to 76-13-21, Removal/Installation.

2. Trim Unit (PNC)

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanners	
range 50-60 lbf in (0.57-0.68 mdaN)	-
60-70 lbf in (0.68-0.79 mdaN)	-
200-220 lbf in (2.26-2.49 mdaN)	-
High temperature resistant nimonic wire 0.031 in (0.8 mm) dia.	DTD747
Circuit breaker safety clips	-

B. Prepare to Remove Trim Unit

(1) Trip the appropriate circuit breakers and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No.1			
ENG 1 MAIN THROT SUP	2-213	1K 1	F12
ENG 1 MAIN THROT SUP	3-213	1K 3	A 1

R	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
R				
R	ENG 1 ALTN THROT SUP	14-215	1K2	G12
R	ENG 1 ALTN THROT CONT	15-216	1K4	E 8
R	ENG 1 REHEAT CONT	15-216	1K1542	E 9
R	ENG 1 REHEAT AMP SUP	14-215	1K1541	C12
R	Engine No.2			
R	ENG 2 MAIN THROT SUP	2-213	2K1	C12
R	ENG 2 MAIN THROT CONT	1-213	2K3	A 3
R	ENG 2 ALTN THROT SUP	13-215	2K2	F14
R	ENG 2 ALTN THROT CONT	15-215	2K4	F15
R	ENG 2 REHEAT CONT	15-215	2K1542	D15
R	ENG 2 REHEAT AMP SUP	13-215	2K1541	B14
R	Engine No.3			
R	ENG 3 MAIN THROT SUP	2-213	3K1	C13
R	ENG 3 MAIN THROT CONT	1-213	3K3	A 4
R	ENG 3 ALTN THROT SUP	13-216	3K2	A 7
R	ENG 3 ALTN THROT CONT	15-215	3K4	F16
R	ENG 3 REHEAT CONT	15-215	3K1542	D16
R	ENG 3 REHEAT AMP SUP	13-216	3K1541	B 7
R	Engine No.4			
R	ENG 4 MAIN THROT SUP	2-213	4K1	F13
R	ENG 4 MAIN THROT CONT	3-213	4K3	A 2
R	ENG 4 ALTN THROT SUP	14-216	4K2	C 7
R	ENG 4 ALTN THROT CONT	15-216	4K4	F11
R	ENG 4 REHEAT CONT	15-216	4K1542	E10
R	ENG 4 REHEAT AMP SUP	14-216	4K1541	D 7

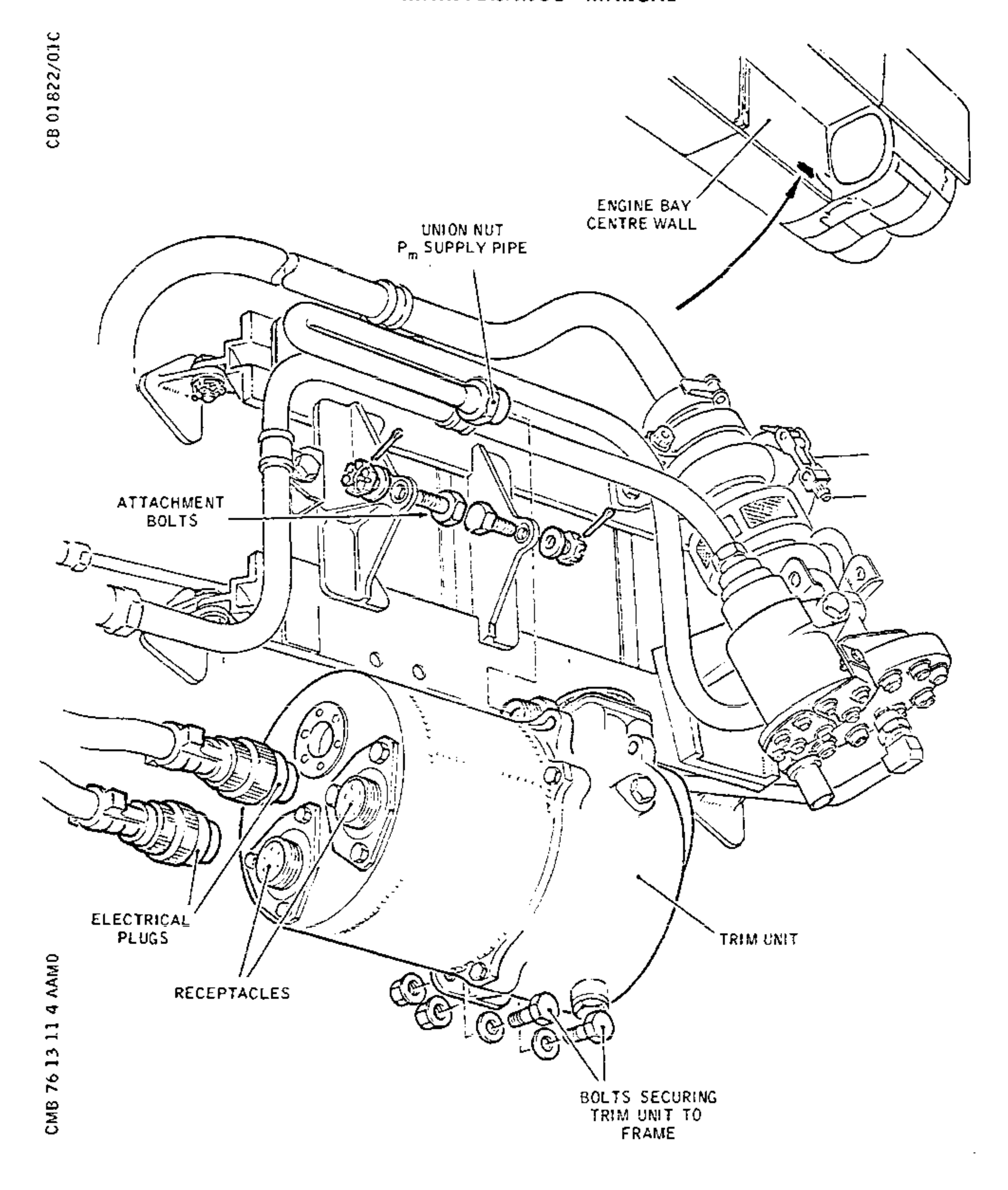
(2) Place a suitable warning placard on the engine starting panel indicating that personnel are working on the power plant.

(3) Open the engine bay doors (Ref. 71-00-00, Servicing).

C. Remove Trim Unit (Ref. Fig. 401)

(1) Disconnect the electrical connections.

(2) Remove the locking wire and unscrew the union nut securing the Pm supply pipe to the connection on the trim unit.



R

Trim Unit - Removal/Installation
Figure 401

(3) Remove the bolts securing the trim unit to the frame.

(4) Remove the split pins and the nuts and washers securing the attachment bolts which attach the trim unit to its support brackets. Temporarily retain the loose bushes for installation.

NOTE: To avoid oil spillage the trim unit is to be supported in its aircraft attitude.

(5) Support the trim unit, remove the bolts, and the unit.

(6) Blank off the air pipe and the port on the trim unit body using approved blanks.

(7) When the trim unit is to be returned for servicing, drain the trim unit (Ref. 76-13-11, Servicing).

D. Install Trim Unit

R (1) Paragraph deleted.

(2) Comply with the electrical safety precautions.

(3) Check that the safety measures in para.2B are intact.

(4) Ensure that bushes are installed in each of the two bolt holes in the attachment brackets.

(5) Fill the trim unit with oil (Ref. 76-13-11, servicing.

NOTE: To avoid oil spillage support the trim unit in its aircraft attitude.

(6) Support the trim unit in position and secure it to the support brackets with bolts, washers and nuts. Torque load each nut to between 50 and 60 lb in (0.57 and 0.68 mdaN) and lock it with a split pin.

(7) Secure the two bolts washers and self-locking nuts securing the trim unit to the frame. Torque load each nut to between 60 and 70 lb in (0.67 and 0.78 mdaN).

(8) Remove the blanks and secure the Pm supply pipe to the connection on the trim unit. Tighten the union nut and torque load it to between 200 and 220 lb in (2.26 and 2.49 mdaN); lock the nut with wire.

(9) Connect the electrical cables to the trim unit ensuring that the connections are made in accordance with the cable identification and the applicable wiring diagram.

E. Conclusion

(1) Ensure that the area is clean.

(2) Remove the warning placard from the engine starting panel.

(3) Remove the safety clips and reset the circuit breakers previously tripped.

(4) Check the functioning of the primary nozzle on an engine ground run by adjusting the PNC trim as necessary by the procedure given in 71-00-00, Adjustment/Test.

PRIMARY NOZZLE CONTROL (PNC) ASSEMBLY PNEUMATIC VALVE - DESCRIPTION AND OPERATION

1. General

The primary nozzle control assembly consists of the pneumatic valve and a trim unit that act together to control the primary nozzle area. The pneumatic valve is described in this chapter and the trim unit in 76-13-11.

2. Description (Ref. Fig. 001)

The pneumatic valve, shown in the illustration, is a servo operated valve controlling the actuating air to the eighteen pneumatic jacks of the primary nozzle.

A piston chamber is bolted to a valve body and provides the connection points for the pneumatic system actuating air tubes and also exhaust air outlets. The sensing signal and the servo connections and outlets are on the valve body.

The actuating P3 air inlet connection is at the end of the piston chamber in which a filter is located. One outlet on the side of the piston chamber provides a connection for the tube to the nozzle closing side of the actuating jacks. The second outlet is protected against the ingress of dirt by a perforated disk. Air exhaust ports in the piston chamber walls are also protected by filters. A piston and spool valve in the chamber bore has a range of movement on either side of a neutral, steady state position.

The larger diameter piston end of the piston and spool valve is loaded toward the air inlet end of the piston chamber by a spring that retains a sealing plug in the piston bore. The plug carries a feedback needle that is initially parallel and terminates in a taper and protrudes into the valve body. The parallel section forms a fixed orifice with a hole into a servo pressure chamber and the tapered section forms a variable orifice into the capsule chamber.

The valve body incoporates a capsule with a servo pin and cap which covers the opening in an orifice piece that connects to the spring side of the piston. Another tapered needle, adjustable for setting purposes, penetrates an orifice leading from the capsule chamber passages to exhaust. A sensing pressure inlet connection for jet pipe pressure Pj on the capsule chamber cover leads to the interior of the capsule. A P3 sensing servo pressure flow connects to an inlet connection at the filter mounted on the valve body. A further external connection from the capsule chamber is made to the primary nozzle control trim unit. The trim unit controls a

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P3 SERVO
P3 ACTUATING
P3
CONTROLLED FLOW TO ACTUATING JACKS
PISTON AND SPOOL VALVE
CONTROL PRESSURE Pc
REFERENCE PRESSURE PM AIR CONNECTION
Pm
Pm
CAPSULE, SERVO PIN AND CAP
PJ
P3 ACTUATING AIR CONNECTION
TO ACTUATING JACK CLOSING SIDE
PISTON AND SPOOL VALVE
P3 (SERVO) AIR CONNECTION
ORIFICE PIECE
SERVO PIN AND CAP
FEEDBACK NEEDLE
CAPSULE CHAMBER
JET PIPE PRESSURE PJ CONNECTION

CMR 76 13 12 0 AAMO

PNC Pneumatic Valve
Figure 001

variable orifice which is effective in the control valve capsule chamber system.

The capsule chamber has the fixed orifice outlet, determined by the adjustable needle, and the variable orifice outlet located in the PNC trim unit. The P3 air inlet into the capsule chamber is by way of the orifice formed by the tapered section of the piston feedback needle and is determined by the piston position. The potentiometer formed by the orifices establishes a reference pressure Pm effective in the capsule chamber.

The servo pressure chamber formed at the piston end of the piston chamber has a fixed orifice inlet at the parallel section of the feedback needle and a variable outlet at the orifice piece and servo cap. The potentiometer formed by these orifices establishes a servo pressure PP derived from the same P3 pressure source as the reference pressure Pm. Spill air from the servo cap and orifice passes to atmosphere via a filter covered exhaust port.

The pneumatic valve controls the air supply to the primary nozzle actuating jacks to operate the jacks in a closing sense. The jet pipe gas flow acts on the primary nozzle in an opening sense and in opposition to the force exerted by the actuating air. Jet pipe pressure PJ is dependant on the nozzle setting.

The actuating air supply to the primary nozzle jacks is controlled by the piston and spool valve position which, in turn, is controlled by the action of the capsule and its servo valve. The capsule acts to control the primary nozzle setting to maintain a balance between the sensed operating pressure PJ and the controlling reference pressure Pm which are acting on it.

In any primary nozzle steady state setting, the piston and spool valve is held in an equivalent steady state position by the balance of forces acting on it. The air supply pressure P3 acts on the spool end in opposition to the spring loading suplemented by servo pressure PP on the piston end. The required value of servo pressure is established by the positioning of the servo cap to the orifice piece under the control of the capsule. The capsule position is set by the reference pressure Pm in the capsule chamber acting in opposition to jet pipe pressure Pj inside the capsule. Any tendency of the primary nozzle to move from the required setting would cause a change in the jet pipe pressure which, in turn would initiate a spool movement in a sense to restore the nozzle setting and re-establish the steady state condition.

When the engine control demands a change of nozzle setting, the trim unit is activated to reset its tapered needle position in the outlet orifice. The change in potentiometer values results in a change of reference pressure Pm. The capsule responds to the change, moves the servo cap and alters the rate of spill of servo pressure. The balance of forces acting on the piston and spool valve are upset and it moves from the existing steady state position to bring about the nozzle setting demanded and then re-establish a new steady state condition.

An increase of trim unit orifice reduces reference pressure Pm and the capsule moves the servo cap to close off the spill from the orifice and servo pressure PAP is decreased. The forces acting on the piston now exceed the force exerted by P3 pressure on the spool end and the piston and spool valve moves and reduces the air supply acting on the nozzle actuating jacks in a closing sense. The gas flow pressure in the jet pipe acts to open the nozzle petals. As the piston and spool valve moves, the orifice formed by the tapered end of the feedback needle increases and air flow into the chamber increases and tends to oppose the rate of control decrease in Pm. This occurs at the same time as jet pipe pressure Pj is decreasing as a result of the change of primary nozzle setting and the capsule and servo control response to the changing Pj signal is quicker and the actuating jack action is smooth and without oscillation. As a result, the servo cap moves to spill servo pressure PAP and reduce the forces acting on the piston and the piston and spool valve moves in a sense to close the port to the actuating jacks. A steady state condition is then established in which a new nozzle setting and jet pipe pressure Pj is in balance with a new trim unit orifice setting and reference pressure Pm such as to give a servo controlled servo pressure PP that keeps the piston and spool valve in the neutral position.

A decrease of trim unit orifice increases reference pressure Pm and results in a servo control action that moves the piston and spool valve to reduce the P3 air directed into the closing side of the nozzle actuating jack pistons. Once the desired nozzle setting is obtained a new steady state condition is established. The feedback needle acts to smooth the actuating jack movement and accelerate servo response in a similar manner as when the nozzle petals are moved in the opening sense.

R PRIMARY NOZZLE CONTROL (PNC) ASSEMBLY PNEUMATIC VALVE - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

CAUTION: BEFORE PRESSURE TESTING OR CLEANING THE P3, Pm OR Pj PIPES THEY MUST BE DISCONNECTED FROM THE PNC VALVE TO AVOID POSSIBILITY OF INTERNAL DAMAGE TO THE VALVE.

A primary nozzle control (PNC) pneumatic valve is part of the primary nozzle control system in each engine bay. Each unit is secured to the bottom rear centrewall panel and access is gained by opening the engine bay doors. Where the PNC units are to be removed for jet pipe servicing refer to 76-13-21, Removal/Installation.

B NOTE: If PNC pneumatic valve is being changed for an aircraft
B defect, check security of mounting frame. If mounting frame
B is loose on its mounting, it should be removed as soon as
B possible for repair i.a.w. 71-41-11 or BA R.S. 71-30548.

2. PNC Valve

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanners range 0-100 lbf in (0-1.13 mdaN) 100-220 lbf in (1.13-2.48 mdaN)	 - -
Locking wire, high temperature resistant nimonic 0.031 in (0.8 mm) dia.	DTD747
Circuit breaker safety clips	-
Identification clip assembly	B445456

B. Prepare to Remove Valve

(1) Trip the circuit breakers listed and fit safety clips:

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No.1			
ENG 1 LH IGNITION CONT	3-213	1J1	E 1
ENG 1 RH IGNITION CONT	1-213	1J2	N 6
ENG 1 BAY COOLING FLAP CONT & IND	3-213	1K231	F 1
ENG 1 MAIN THROT SUP	2-213	1K1	F12
ENG 1 MAIN THROT CONT	3-213	1K3	A 1
ENG 1 ALTN THROT SUP	14-215	1K2	G12
ENG 1 ALTN THROT CONT	15-216	1K4	E 8
ENG 1 REHEAT CONT	15-216	1K1542	E 9
ENG 1 REHEAT AMP SUP	14-215	1K1541	C12
Engine No.2			
ENG 2 LH IGNITION CONT	3-213	2J1	E 2
ENG 2 RH IGNITION CONT	1-213	2J2	P 6
ENG 2 BAY COOLING FLAP CONT & IND	1-213	2K231	D 3
ENG 2 MAIN THROT SUP	2-213	2K1	C12
ENG 2 MAIN THROT CONT	1-213	2K3	A 3
ENG 2 ALTN THROT SUP	13-215	2K2	F14
ENG 2 ALTN THROT CONT	15-215	2K4	F15
ENG 2 REHEAT CONT	15-215	2K1542	D15
ENG 2 REHEAT AMP SUP	13-215	2K1541	B14
Engine No.3			
ENG 3 LH IGNITION CONT	3-213	3J1	E 3
ENG 3 RH IGNITION CONT	1-213	3J2	Q 6
ENG 3 BAY COOLING FLAP CONT & IND	1-213	3K231	D 4
ENG 3 MAIN THROT SUP	2-213	3K1	C13
ENG 3 MAIN THROT CONT	1-213	3K3	A 4
ENG 3 ALTN THROT SUP	13-216	3K2	A 7
ENG 3 ALTN THROT CONT	15-215	3K4	F16
ENG 3 REHEAT CONT	15-215	3K1542	D16
ENG 3 REHEAT AMP SUP	13-216	3K1541	B 7
Engine No.4			
ENG 4 LH IGNITION CONT	3-213	4J1	E 4
ENG 4 RH IGNITION CONT	1-213	4J2	R 6
ENG 4 BAY COOLING FLAP CONT & IND	3-213	4K231	F 2
ENG 4 MAIN THROT SUP	2-213	4K1	F13
ENG 4 MAIN THROT CONT	3-213	4K3	A 2
ENG 4 ALTN THROT SUP	14-216	4K2	C 7
ENG 4 ALTN THROT CONT	15-216	4K4	F11
ENG 4 REHEAT CONT	15-216	4K1542	E10
ENG 4 REHEAT AMP SUP	14-216	4K1541	D 7

(2) Place a suitable warning placard on the engine starting panel indicating that personnel are working on the power plant.

(3) Open the engine bay door (Ref. 71-00-00, Servicing).

C. Remove PNC Valve (Ref. Fig. 401)

(1) Slacken the nuts securing the following pipes:

(a) P3 signal pipe.

(b) Pm supply pipe.

(c) Pj supply pipe.

(2) Slacken the nuts securing the pipe clamps, for the P3 supply pipe and the 'nozzle closed' supply pipe, remove the clamps.

(3) Remove the bolts and half-clamp securing the top of the valve to the frame.

(4) Support the PNC valve and remove the split pins and bolts (two) securing the valve to its support bracket retaining the loose bush for installation. Remove the valve.

(5) Fit approved blanks to the pipe ends and to the openings on the valve body.

(6) If the control valve is to be returned for overhaul, secure an identification clip on the valve bayonet assembly so that the clip covers the vent holes.

NOTE: After SBOL.593-76-GSE.34-46, fit a protector instead of the identification clip.

D. Prepare to install Valve

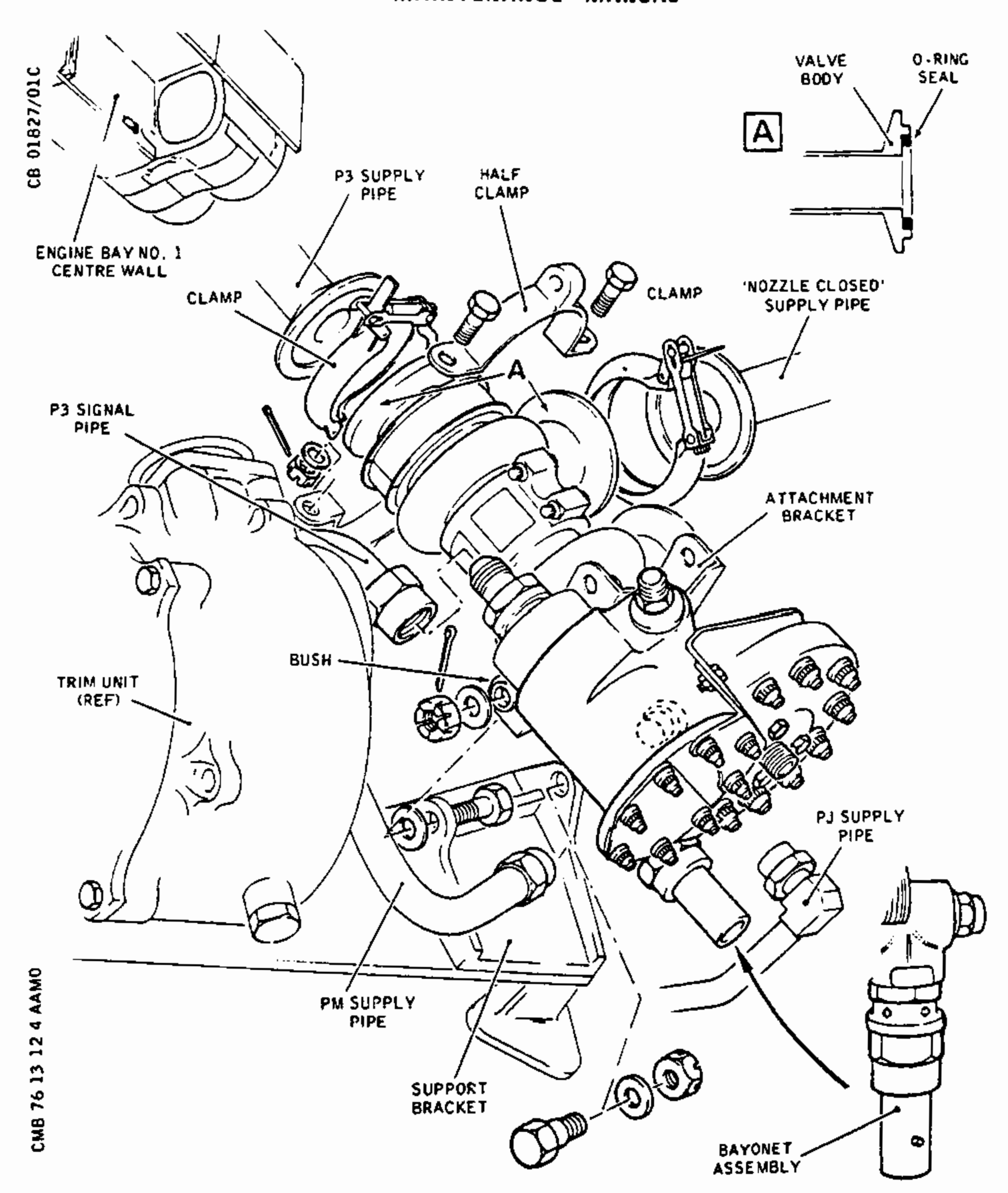
(1) Inspect PNC mounting tray checking for security of attachment and signs of cracking. Any such distress must be rectified prior to installing the PNC.

(2) Check all air pipes (P3 supply, P3 signal, P7 signal and nozzle supply) for condition and security of attachment. Rectify as necessary.

B (3) Remove retaining ring (AS2030-43) from the end of the
B chamber and withdraw filter (B440445).

B (4) Using finger pressure exercise the piston (B493119) in
B the chamber checking for free and smooth movement.

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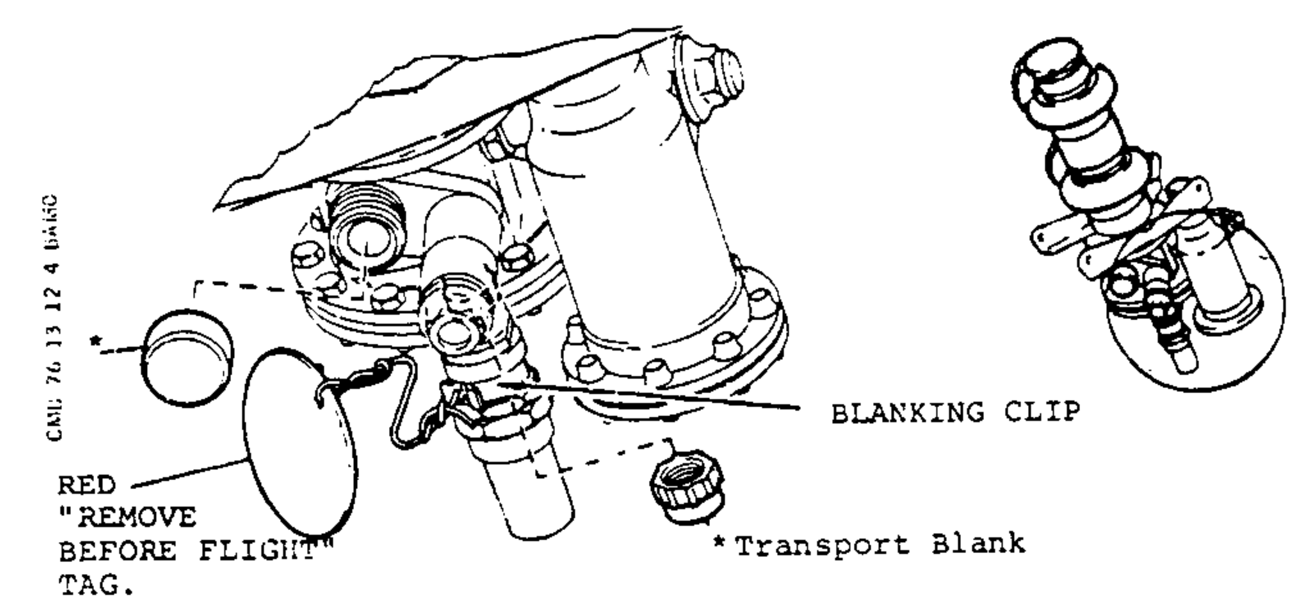


Primary Nozzle Control Valve -
Removal/Installation
Figure 401

R

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Blanking Clip Removal from Metered Air
Pressure Exhaust Holes
Figure 402

B (5) Install filter and retaining ring.

E. Install Valve (Ref. Fig. 401 and 402)

CAUTION: WHENEVER A PNC IS INSTALLED ON THE ENGINE, CHECK THAT THE BLANKING CLIP IS REMOVED FROM THE METERED AIR PRESSURE EXHAUST HOLES JUST ABOVE THE TRIM ADJUSTER BARREL - SEE FIG. 402.

NOTE: Instances have occurred when the red "Remove Before Flight" tag along with its nylon attach cord was missing thus making it very difficult to see that the blanking clip is fitted. (EN.6275).

(1) Comply with the electrical safety precautions.

(2) Check that the safety measures in para.2.B. are intact.

(3) Ensure that a bush is fitted in one end of the attachment bracket.

(4) If a replacement control valve is to be fitted, remove the identification clip (used for transportation) from the valve bayonet assembly and check that the four vent holes are unobstructed.

NOTE: After SBOL.593-76-GSE.34-46, remove the protector instead of the identification clip.

(5) Support the PNC valve in position and secure it to the support bracket with a bush, bolts, washers and nuts. Torque-tighten each nut to between 25 and 30 lbf in (0.28 and 0.34 mdaN) and lock it with a split pin.

(6) Engage the half-clamp securing the top of the valve to the frame and secure it with bolts, washers and nuts. Torque-tighten the nuts to between 25 and 30 lbf in (0.28 and 0.34 mdaN) and lock each nut with a split pin.

(7) Remove the blanks, check that the seatings are clean and undamaged, secure the P3 supply pipe and the 'nozzle closed' pipe to the valve using a new O-ring seal for each pipe. Torque-tighten each pipe clamp nut to 53 lbf in (0.6 mdaN).

(8) Remove the blanks, check that the seatings are clean and undamaged and secure the P3 signal pipe and the Pm supply pipe to the valve body. Torque-tighten each union nut to between 200 and 220 lbf in (2.26 and 2.48 mdaN) and wire-lock in accordance with 20-21-13.

(9) Remove the blanks, check that the seatings are undamaged and secure the Pj supply pipe to the valve body. Torque-tighten the union nut to between 105 and 115 lbf in (1.18 and 1.3 mdaN) and wire-lock in accordance with 20-21-13.

NOTE: Where the P3 signal pipe and the Pj supply pipe cross over below the PN trim unit, check that there is a minimum clearance of 0.25 in. (6.35 mm) between the pipes.

F. Conclusion

(1) Ensure that the area is clean.

(2) Close the engine bay doors (Ref. 71-00-00, Servicing).

(3) Remove the warning placard from the engine start panel.

(4) Remove the safety clips and reset the circuit breakers.

(5) Check the functioning of the primary nozzle on an engine ground run (Ref. 71-00-00, Adjustment/Test).

R PRIMARY NOZZLE CONTROL (PNC) - TROUBLE SHOOTING

1. Olympus 593 - LP Spool Instability (EN 6409).

A. General

Primary nozzle controller (PNC) rejections can be due to either:-
a) N1 and Aj instability or
b) the primary nozzle running fully closed.
The N1 control loop is made up of many components and in certain cases the individual component stability margins can add together to give a noticeable instability of the loop at particular phases of flight. Excessive wear/ clearance of any one particular component can generate loop instability. e.g. Excessive clearance between the piston carbon seal rings and the bore of the PNC.

The particular phase of flight on which poor overall loop stability has the most effect is the transonic descent. The N1 and Aj can become noticeably unstable in the descent when the engines are throttled back to the green band but remain stable during climb and cruise at high engine power settings. For an acceptable limit for instability during descent - see table 1.

The other phase of flight where loop instability may be noticed if the overall loop stability margin is poor is supersonic cruise. N1 loop instability in supersonic cruise will cause the intake ramps to move up and down with corresponding ramp actuator and associated assembly movement. The long term effect of this on the wear rates/reliability of the intake system has yet to be evaluated. Therefore, instability in supersonic cruise should be avoided where possible. The tighter limit shown on table 1 reflects this requirement.

The primary nozzle running fully closed is primarily a PNC problem and a number of modifications are being carried out or are under development to improve individual component design/reliability within the PNC.

B. Procedure

(1) Flight Crew reporting:-

(a) Instability in descent from supersonic cruise

(i) Less than $\pm$ 5% Aj - for information only.

(ii) Greater than ± 5% Aj - for action.

(b) Instability in any other phase of flight - for action.

(2) Troubleshooting as per Table 1.

Table 1

Para	Phase of Flight	Degree of N1 Loop Instability	Action To Be Taken
A	Descent from supersonic cruise Throttle lever in green band	N1 < ± 1 1/2% Aj < ± 5% Same on both ECU lanes	1. Inspect PNC & PN trim signal pipes, PN jack air supply pipe/Manifold for tightness, evidence of air leakage and cracks. 2. Check PN for freedom of movement, i.e. stiction 3. If satisfactory take no further action
B	As A	N1 < ± 1 1/2% Aj < ± % Only on one ECU lane	1. Check respective plug on PN trim for evidence of looseness, oil contamination, pin & socket fit and pin corrosion. Check respective engine disconnect plug. 2. If satisfactory swap main and alternate ECU for evaluation 3. If no improvement accept until instability exceeds ± 5% Aj
C	As A	N1 > ± 1 1/2% Aj&± 5% Same on both	1. As A 1) and A 2) 2. If possible check PNC trim angle

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Para	Phase of Flight	Degree of N1 Loop Instability	Action To Be Taken
		ECU lanes	3. Change PNC 4. Change PN trim 5. Check engine bay and a/c electrical plugs & wiring
D	As A	N1 > ± 1 1/2% Aj > ± 5% Only on one ECU lane	1. As B 1) 2. Change respective ECU 3. Change PN trim 4. Check engine bay and a/c electrical plugs & wiring
E	Stable sub-sonic or super-sonic cruise	N1 < ± 1/2% Aj < ± 1 1/2% Same on both control lanes	1. As A
F	As E	N1 < ± 1/2% Aj > ± 1 1/2% Only on one ECU lane	1. As B but level of acceptable in-stability is ± 1 1/2% Aj
G	As E	N1 > ± 1/2% Aj > 1 1/2% Same on both control lanes	As C
H	As E	N1 > ± 1/2% Aj > ± 1 1/2% Only on one ECU lane	As D
J	Take Off Sub & super-sonic climb Ground Idle	Any recorded N1 loop in-stability Only on one ECU lane	As D

Para	Phase of Flight	Degree of N1 Loop Instability	Action To Be Taken
K	As J	Any recorded N1 loop in-stability On both control lanes	As C

<u>Note</u>: Instability in supersonic climb which includes the N2 loop is most probably due to the reheat control loop. Known causes are:-

1. Connectors to reheat FCU
2. Reheat FCU - incorrect tacho generator feed back signal from metering valve
3. Reheat fuel flow meter
4. Reheat amplifier

PRIMARY NOZZLE TRIM UNIT AND CONTROL VALVE ASSEMBLY - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

To facilitate jet pipe servicing the primary nozzle control (PNC) units, complete with mounting frame, are removed together. The units are secured to the bottom rear centre wall in each engine bay, and are accessible with the engine bay doors open.

This chapter is not to be used for the removal/installation of a defective PNC valve or trim unit for which separate procedures have been written (Ref. 76-13-12 and 76-13-11).
R The weight of the complete assembly and handling equipment is
R approximately 40 lb (18 Kg).

2. Trim Unit and Control Valve Assembly

A. Equipment and Materials

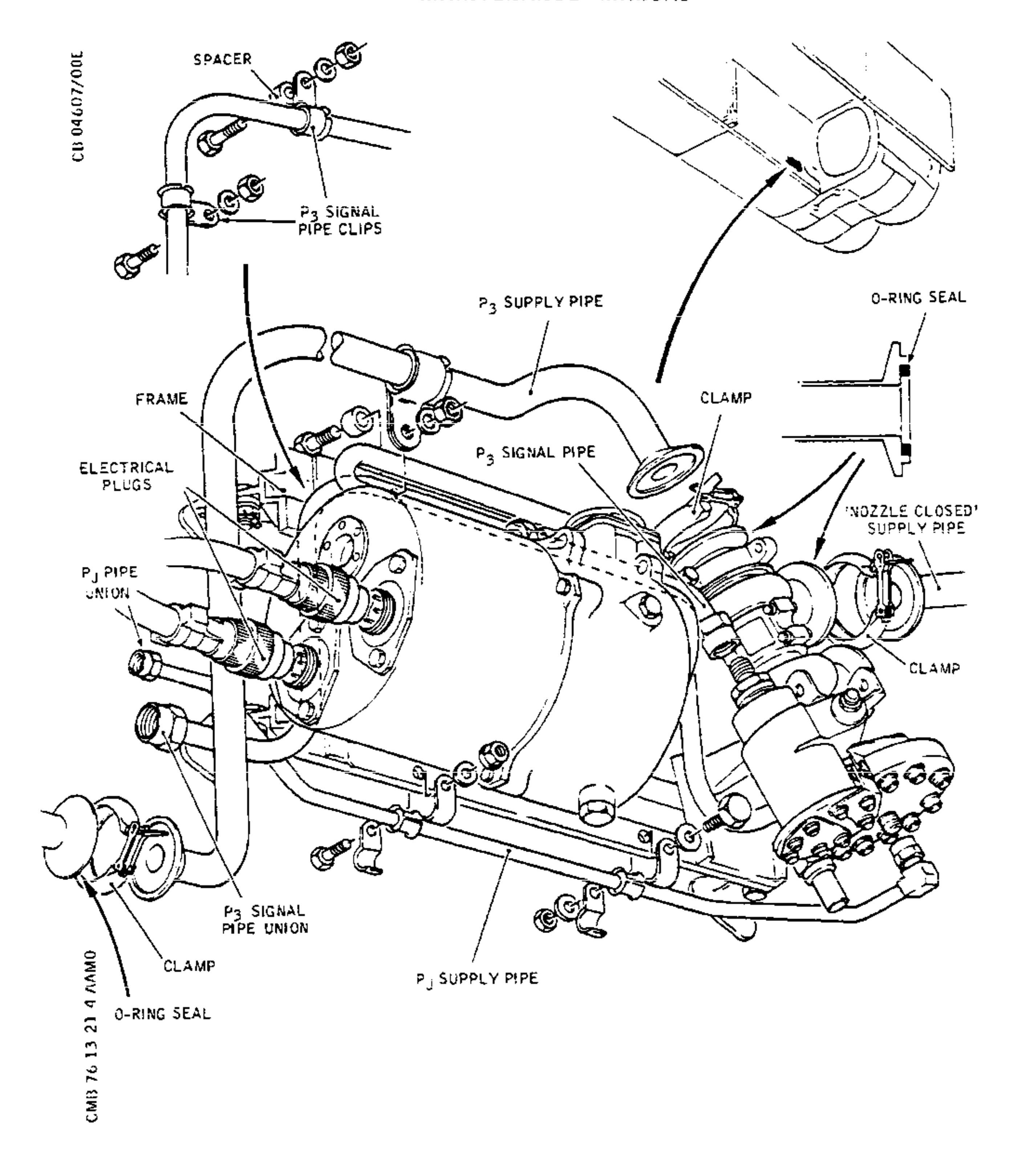
	DESCRIPTION	PART NO.
	Torque spanners	
R	0 - 100 lbf in (0 - 1.13 mdaN)	
R	100-220 lbf in (1.13 - 2.49 mdaN)	-
R	Locking wire high temperature	
R	resistant nimonic	
R	0.031 in (0.81 mm) dia	DTD747
	Circuit breaker safety clips	-
	Stand/handle for primary nozzle control valve and trim unit panel	E935011030

B. Prepare (Ref. Fig.401 and 402)

(1) Place a suitable warning placard on the engine starting panel to indicate that people are working on the power plant.

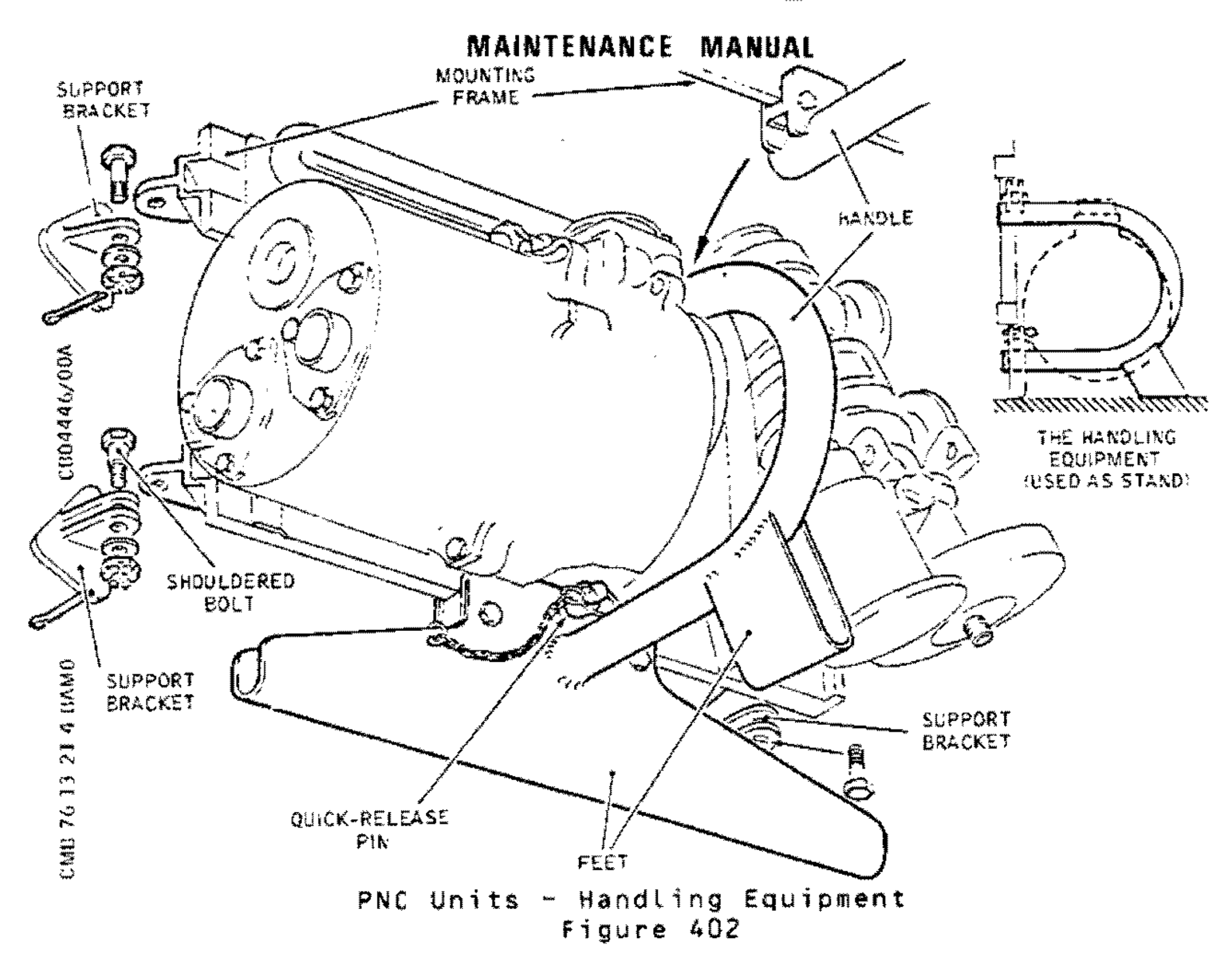
(2) Open the engine bay doors (Ref. 71-00-00, Servicing)

(3) Isolate the following additional circuit breakers and



PNC Units - Removal/Installation
(After SB 76-007)
Figure 401

R



PNC Units - Handling Equipment
Figure 402

secure them with safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No.1			
ENG 1 MAIN THROT CONT	3-213	1K3	A 1
ENG 1 ALTN THROT CONT	15-216	1K4	E 8
Engine No.2			
ENG 2 MAIN THROT CONT	1-213	2K3	A 3
ENG 2 ALTN THROT CONT	15-215	2K4	F15
Engine No.3			
ENG 3 MAIN THROT CONT	1-213	3K3	A 4
ENG 3 ALTN THROT CONT	15-215	3K4	F16

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No.4			
ENG 4 MAIN THROT CONT	3-213	4K3	A 2
ENG 4 ALTN THROT CONT	15-216	4K4	F11

C. Remove

(1) Disconnect the Pj supply pipe to the PNC valve:

(a) Unscrew the union nut securing the pipe to the valve.

(b) Remove the bolt securing the pipe clip to the frame.

(c) Disconnect the pipe at the pipe union and remove the pipe.

(2) Disconnect the P3 signal pipe to the valve:

(a) Unscrew the union nut securing the pipe to the filter unit on the valve.

(b) Remove the bolts securing the pipe clips (two) to the frame.

(c) Disconnect the pipe at the pipe union, and remove the pipe.

(3) Disconnect the P3 supply pipe.

(a) Unscrew the nut securing the pipe clamp at the PNC valve body, remove the clamp.

(b) Remove the bolt securing the pipe clip to the frame.

(c) Unscrew the nut securing the pipe clamp nearest the ground connection and remove the clamp and pipe.

(4) Slacken the nuts securing the nozzle closed supply pipe clamp at the PNC valve, remove the clamp and seal.

(5) Disconnect the electrical connections to the main supply and standby receptacles on the trim unit.

(6) Attach the handling equipment (Ref. Fig. 402) to the PNC unit frame and lock it in position with the quick-release pin.

(7) Remove the split pins and nuts which secure the mounting frame to its support brackets.

NOTE: To avoid oil spillage the PNC units should be stored upright using the handling equipment as a stand.

(8) Support the PNC units and remove the bolts, and the mounting frame and units as a complete assembly.

(9) Install approved blanks on the open ends of the pipes and on the openings on the valve body.

R (10) If the assembly is to be returned for overhaul, remove
R an identification clip on the PNC valve bayonet
R assembly so that the clip covers the vent holes.

R NOTE: After SB OL.593-76-GSE.34-46, fit a protector
R instead of the identification clip.

D. Prepare to Install (Ref. Fig.401 and 402)

(1) Comply with the electrical safety precautions.

NOTE: To avoid oil spillage the complete assembly should be stored upright using the ground handling equipment as a stand.

R (2) Remove the blanks from the openings on the valve (with the exception of the nozzle open supply duct) and from the ends of the pipelines, check that the pipe ends and seatings are clean and undamaged.

R (3) If a replacement assembly is to be fitted, remove the
R identification clip (used for transportation) from the
R valve bayonet assembly and check that the vent holes
R are unobstructed.

R NOTE: After SB OL.593-76-GSE.34-46, remove the pro-
R tector instead of the identification clip.

E. Install

(1) Install the PNC assembly:

(a) Support the PNC units in position and secure the mounting frame to the support brackets at the front with bolts, washers and nuts.

NOTE: A thin washer is fitted to the lower bolt only.

(b) Torque-load each nut to between 50 and 60 lbf in (0.57 and 0.68 mdaN) and lock it with a split pin.

R Before SB 78-010

(c) At the rear end secure the frame with bolts, torque-load the bolts to between 70 and 80 lbf in (0.79 and 90 mdaN) and wire-lock the bolts in accordance with 20-21-13.

R After SB 78-010
R
R (c) At the rear end secure the frame with bolts,
R torque-load the bolts to between 70 and 80 lbf
R in (0.79 and 90 mdaN) and wire-lock the bolts in
R accordance with 20-21-13.
R NOTE: A longer bolt is fitted to the upper rear
R support bracket.

(2) Remove the quick release pin and the ground handling equipment.

(3) Install the P3 supply pipe:

(a) Loosely assemble the pipe clip and pipe to the frame with a bush, clip inner, clip outer, bolt, spacer and washer.

(b) Engage the pipe ends and secure each end with an O-ring seal and clamp. Torque-load each clamp nut to 53 lbf in (0.6 mdaN).

(c) Torque-load the clip bolt to between 70 and 80 lbf in (0.79 - 0.90 mdaN) and wire-lock the bolt in accordance with 20-21-13.

(4) Install the P3 signal pipe:

(a) Loosely assemble the pipe clips and pipe to the frame with bushes, clips inner and outer, bolts and washers. In addition the clip on the horizontal section of the pipe has a spacer.

(b) Engage the pipe ends and secure each end with its union nut, torque-load the union nuts to between 200 and 220 lbf in (2.26 and 2.49 mdaN) and wire-lock the union nuts in accordance with 20-21-13.

(c) Torque-load the clip bolts to between 70 and 80 lbf in (0.79 - 0.90 mdaN) and wire-lock in accordance with 20-21-13.

R After SB 76-007 For A/C 001-006,

(5) Install the Pj supply pipe:

(a) Loosely assemble the pipe and clip to the frame with bushes, clips inner and outer, bolts, washers and nuts.

(b) Engage the pipe ends and secure each end with its union nut, torque-load each union nut to between 105 and 115 lbf in (1.18 and 1.29 mdaN)
R and wire-lock the union nuts in accordance with
R 20-21-13.

(c) Torque-load the clip bolts to between 30 and 40 lbf in (0.339 and 0.452 mdaN).

(5) Install the Pj supply pipe:

NOTE: Where the P3 signal pipe and the Pj supply pipe cross over below the PN trim unit, check that there is a minimum clearance of 0.25 in (6.35 mm) between the pipes.

(a) Loosely assemble the pipe and clip to the frame with a bush, clip inner and outer, bolt, washer and a nut.

(b) Engage the pipe ends and secure each end with its union nut, torque-load each union nut to between 105 and 115 lbf in (1.18 and 1.29 mdaN) and wire-
R lock the union nuts in accordance with 20-21-13.

(c) Torque-load the clip bolt to between 25 and 30 lbf in (0.28 and 0.34 mdaN) and lock it with a split pin.

(6) Secure the nozzle closed supply pipe to the valve using a pipe clamp and an O-ring seal, torque-load the clamp nut to 53 lbf in (0.6 mdaN).

(7) Check that the electrical connectors are clean and undamaged and reconnect to the trim unit ensuring that the connections are made in accordance with the connector identification and the applicable wiring diagram.

F. Conclusion

(1) Ensure that the area is clean.

(2) Close the engine bay doors (Ref. 71-00-00,Servicing).

(3) Remove the warning placard from the 3CM station.

(4) Remove the safety clips and reset the circuit breakers previously tripped.

(5) Check the functioning of primary nozzle on an engine ground run (Ref 71-00-00, Adjustment/Test).

REHEAT CONTROL SYSTEM - ADJUSTMENT/TEST

1. General

This chapter gives all the information required for the use
R of the reheat test equipment, namely: the reheat test set and
R the reheat test box.

The reheat test set is used during the periodic checks described in the Maintenance Programme and is also used during the accomplishment of the Fault Isolation procedures as well as the reheat test box (Ref. Trouble Shooting 71-00-49).

The directions for use of this test set are first detailed in automatic mode. This procedure enables the operators to check, in a very simple and very quick manner, if the electrical and electronic circuits are operational and if no noticeable discrepancy occurs during the sequences (Ref. Fig.503 and 504). The check of the reheat control system in manual mode is especially carried out within the trouble-shooting framework. It is possible to measure separately the signals to and from the reheat control amplifier, to control accurately certain points of the programmes Fr/Fe which have been fed in the amplifier and to measure the parameter thresholds governing some sequences. Globally, the use of the test set in manual mode gives the operators the opportunity to multiply checks without limitation of duration. In this configuration, which necessitates a longer preparation time than required in automatic mode, the control signals (N1 speed = Fr fuel flow - Fe fuel flow - Temperature Tt1) are individually generated and continuously adjustable.

R Instructions for use of the Reheat Test Box are given in
R paragraph 4 permitting limited checks such as Reheat Ignition
System Checks, energizing of the reheat shut-off valve, operation of the reheat throttle motor, integrity of the Fr and Fe electrical lines.

2. Reheat Test Set Use in Automatic Mode

A. Equipment and Materials

DESCRIPTION	PART NO.
Reheat test set	9970-531-034
Circuit breaker safety clips	-

B. Prepare to Carry out Reheat Control System Test

WARNING: THE REHEAT FLAME DETECTOR (IONISATION) IS ENERGIZED UNDER 150 V AS LONG AS THE REHEAT CIRCUITS REMAIN ELECTRICALLY SUPPLIED FOR FAULT ISOLATION PURPOSES. FURTHERMORE, THE REHEAT IGNITION HIGH ENERGY VOLTAGE IS POTENTIALLY LETHAL. COMPLY WITH THE SAFETY PRECAUTION DETAILED IN CHAPTER 12. BEFORE CARRYING OUT ANY VISUAL INSPECTION OF AREAS INSIDE THE REHEAT CHAMBER WHICH REQUIRES THE OPERATOR TO COME CLOSE TO THE BUCKETS, MAKE SURE THAT NO SOURCE OF COMPRESSED AIR IS CONNECTED TO THE GROUND CONNECTORS OF THE TWIN SECONDARY NOZZLE.

(1) Position the throttle lever fully rearward in its gate with thrust reverse fully down.

(2) Switch Off the "REHEAT" switch at Pilot station.

(3) Ensure that the reheat system supply circuit breakers are set (Ref. Table 501).

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
ENGINE No. 1			
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C12
REHEAT IGN SUP PH C	14-215	1K1544	F12
REHEAT IGN SUP PH A	14-215	1K1543	B13
ENGINE No. 2			
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	13-215	2K1541	B14
REHEAT IGN SUP PH A	13-215	2K1543	A14
REHEAT IGN SUP PH C	13-215	2K1544	E14
ENGINE No. 3			
REHEAT CONT	15-215	3K1542	D16
REHEAT AMP SUP	13-216	3K1541	B 7
REHEAT IGN SUP PH A	13-216	3K1543	A 5
REHEAT IGN SUP PH C	13-216	3K1544	F 6
ENGINE No. 4			

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
REHEAT CONT	15-216	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7
REHEAT IGN SUP PH A	14-216	4K1543	A 6
REHEAT IGN SUP PH C	14-216	4K1544	E 7

Circuit Breakers
Table 501

(4) Prepare the test set

(a) Place the mode selector on "MAN".

(b) Switch Off the "ON/OFF TEST SET" switch.

(c) Switch Off "Ttl - Fe - Fr - N1".

(5) Connect the reheat test set to the reheat control amplifier.

(6) Depress the "TEST IND. LIGHTS" test set push-button and check that all the indicating lights illuminate.

(7) Switch on "TEST SET ON/OFF" (Supply).

(8) Place the A.C. Selector in position "MOTOR CONT.".

(9) Switch On "Ttl - Fe - Fr - N1".

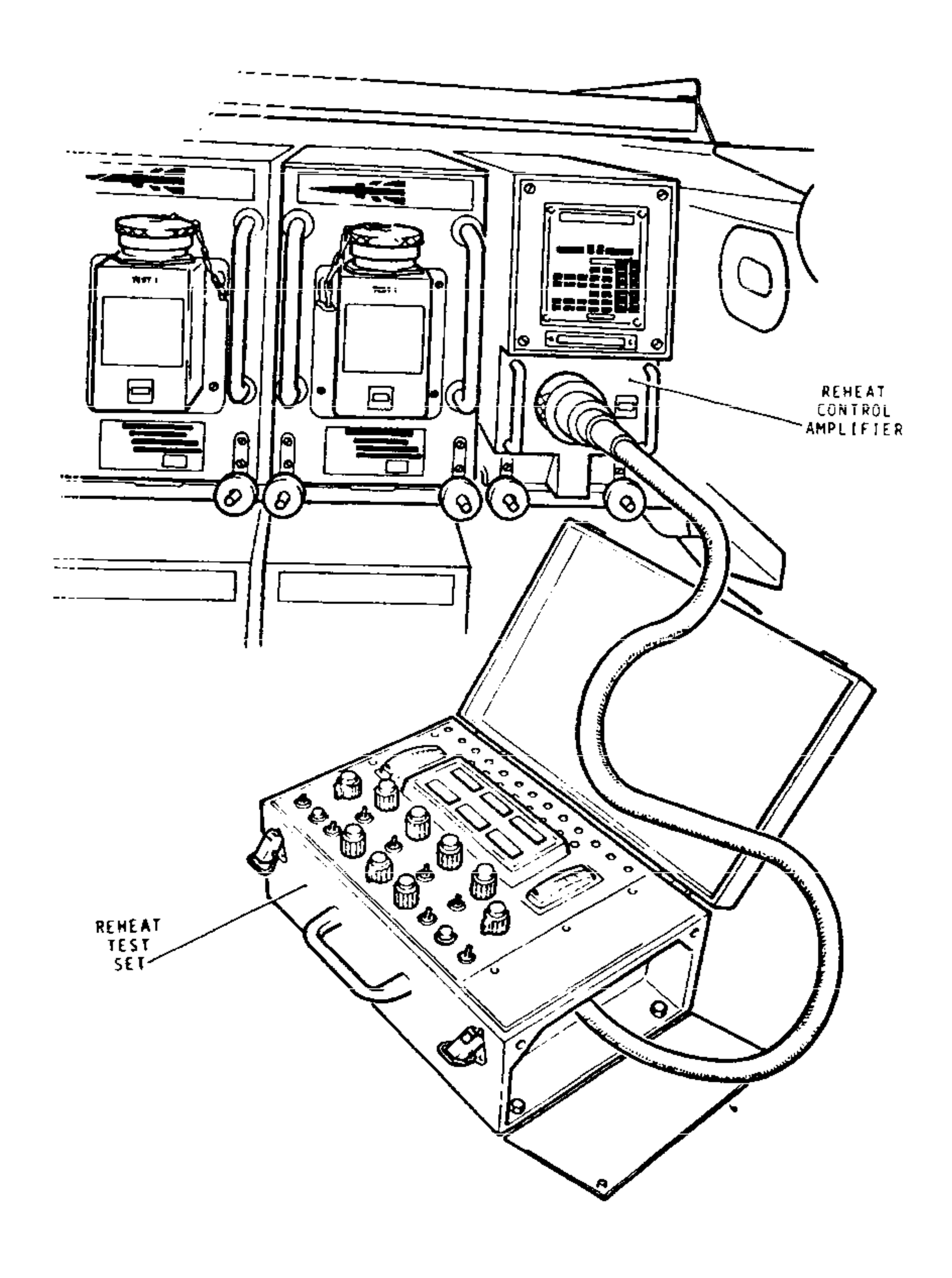
C. Check the Light-Up Sequences.

(1) Place the selector "AUTO-MAN-DYN" on "AUTO" and check the light-up sequences by observing the test set indicating lights and checking for existing tacho gene output voltage on the digital voltmeter.

NOTE: Lighting-up and extinction of indicating light sequences are given in the illustration (Ref. Fig.503 and 504).

(2) Read "Fr LIGHT-UP" on the digital voltmeter during light-up sequence. Fr must be between 44 and 46 Hz.

(3) Check that "METERING-VALVE OPEN" and "METERING VALVE CLOSED" light indicators are Off when "IGNITION RELAY"



CMS 76 15 00 5 AACO

Reheat Test Set Connected to Reheat Control Amplifier
Figure 501

CMS 76 15 00 5 AAEO

28V | 115V | REHEAT ON | ALPHA 10° | 90 | SAFETY RELAY | S.O.V.S | FLAME DETECTION | PURGE OPEN | IGNITION RELAY | TRANSF. ENERG.

CONTINGENCY | FLIGHT | FAULT | METERING VALVE OPEN | CLOSED | AUTOM.STOP | PURGE CLOSED | PURGE SOLENOID

V ∿ — AMPLIFIER OUTPUT VOLTAGES

V ═ — AMPLIFIER OUTPUT VOLTAGES

Tt1 (U)	Fr or NL (Hz)	Fr/Fe PROG. (U)
04,10	093,6	08,83
0030	120,0	027,5
PROG.Fr/LIGHTING UP	Fe (Hz)	TACHO. GENE. (U)

MOTOR CONT | MOTOR REF | FLAME DETECTOR | 115V | PURGE VALVE TRANSD.

Tt1 | Fe | Fr | NL

ON OFF | ON OFF | ON OFF | ON OFF

REHEAT ON/OFF | I.R | S.O.V.S | 97% | S.R | 10% | FAULT | 28V | PURGE SOLENOID

ON OFF — TEST SET

TEST — IND.LIGHTS

MAN | AUTO | DYN

NL

SIMULATED ON OFF — FLAME DETECTOR

Reheat Test Set Console Layout
Figure 502

R

EFFECTIVITY: ALL

BA

		COCKPIT AND TEST SET PREPARATION	CHECK OF LIGHT-UP SEQUENCES
COCKPIT	THROTTLE LEVER POSITION	IDLE	
	REHEAT CONTROL SWITCH	OFF	
	28 V	28 V	
	115 V	115 V	
	REHEAT ON		ON
TEST SET INCATING LIGHTS	CONTINGENCY		
	FLIGHT		
	ALPHA 10 %		10 %
	90 %		90 %
	METERING VALVE "OPEN/CLOSED"		OPEN / OFF
	SAFETY RELAY		
	S.O.V.S		
	PURGE CLOSED		
	PURGE SOLENOID		
	IGNITION RELAY (I.R)		
	FAULT		
	FLAME DETECTION		
	AUTOM.STOP		
	TRANSF. ENERG.		
SIMULATION	N1		
	Fr		
	Fe		
	Ttl		
	FLAME		
DIGITAL MEASURING	Ttl		READ "Fr LIGHT-UP" VALUE
	Fr or Fe	CHECK FOR EXISTING TACHO GENE VOLTAGE OUTPUT (SHORT DURATION)	
	READ Fr/Fe PROG.		
	READ Fr LIGHT-UP PROGR.		
	READ Fe		
	U TACHO GENE		
	D.C POINTER VOLTMETER		
	A.C POINTER VOLTMETER		
TEST SET SWITCHES	MAN/AUTO/DYN		AUTO
	TEST SET "ON/OFF" (Supply)		
	INDICATING LIGHTS TEST	TEST	
	A.C SELECTOR POSITION		METERING VALVE MOTOR CONTROL
	D.C SELECTOR POSITION		
	Ttl	ON	
	Fe	ON	
	Fr	ON	
	N1	ON	

CONNECT TEST SET TO REHEAT CONTROL AMPLIFIER

Continued on figure 504

CMS 76 15 00 5 AAMO

R

Basic Check in Automatic Mode
Figure 503

R

Basic Check in Automatic Mode
Figure 504

goes Off.

(4) Check for existing tacho gene output voltage at beginning and at end of light-up sequence.

D. Check the Fr/Fe Programme.

(1) Check that Tt1 simulated by the test set is 5.10 V plus or minus 10 mV and that Fe is 100 Hz.

(2) Check that Fr/Fe versus Tt1 is in accordance with the amplifier programmed law selected.

(a) Fr/Fe for Take-Off must be 0.78 plus or minus 2 per cent.

(b) Fr/Fe for Flight must be 0.60 plus or minus 2 per cent.

(c) Fr/Fe for Contingency must be 0.90 plus or minus 2 per cent.

E. Check of Reheat Shut-Off Sequences.

(1) Check that "METERING VALVE CLOSED" is on during 15 seconds approx.

(2) Check for existing tacho gene output voltage at the moment "CLOSED" light goes On.

(3) Check that "PURGE SOLENOID" light goes On after period of 5 seconds starting from the moment "METERING VALVE CLOSED" light goes On. Check that "PURGE SOLENOID" goes Off after period of 5 seconds.

F. End of Check Procedure.

(1) At the end of reheat shut-off sequence, check that only the "28V - 115V - PURGE CLOSED" lights remain On.

(2) Disconnect the reheat test set from reheat control amplifier.

3. Reheat Test Set Use in Manual Mode

A. Equipment and Materials

DESCRIPTION	PART NO.
Reheat test set	9970-531-034
Circuit breaker safety clips	-

B. Prepare to Carry-Out Reheat Control System Test

<u>WARNING</u>: THE REHEAT FLAME DETECTOR (IONISATION) IS ENERGIZED UNDER 150 V AS LONG AS THE REHEAT CIRCUITS REMAIN ELECTRICALLY SUPPLIED FOR FAULT ISOLATION PURPOSES. FURTHERMORE, THE REHEAT IGNITION HIGH ENERGY VOLTAGE IS POTENTIALLY LETHAL. COMPLY WITH THE SAFETY PRECAUTION DETAILED IN CHAPTER 12. BEFORE CARRYING OUT ANY VISUAL INSPECTION OF AREAS INSIDE THE REHEAT CHAMBER WHICH REQUIRES THE OPERATOR TO COME CLOSE TO THE BUCKETS, MAKE SURE THAT NO SOURCE OF COMPRESSED AIR IS CONNECTD TO THE GROUND CONNECTORS OF THE TWIN SECONDARY NOZZLE.

(1) Position the throttle lever fully rearward in its gate with thrust reverse lever fully down.

(2) Switch On "REHEAT" at Pilot station.

(3) Ensure that the reheat system supply circuit breakers are set (Ref. Table 502).

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENGINE No. 1			
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C12
REHEAT IGN SUP PH A	14-215	1K1543	B13
REHEAT IGN SUP PH C	14-215	1K1544	F12
ENGINE No. 2			
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	13-215	2K1541	B14
REHEAT IGN SUP PH A	13-215	2K1543	A14
REHEAT IGN SUP PH C	13-215	2K1544	E14

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENGINE No. 3			
REHEAT CONT	15-215	3K1542	D16
REHEAT AMP SUP	13-216	3K1541	B 7
REHEAT IGN SUP PH A	13-216	3K1543	A 5
REHEAT IGN SUP PH C	13-216	3K1544	F 6
ENGINE No. 4			
REHEAT CONT	15-216	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7
REHEAT IGN SUP PH A	14-216	4K1543	A 6
REHEAT IGN SUP PH C	14-216	4K1544	E 7

Circuit Breakers
R Table 502

(4) Prepare the test set (Ref. Fig. 505)

(a) Place the mode selector on "MAN".

(b) Switch Off the "ON/OFF TEST SET" switch.

(c) Switch OFF "Ttl - Fe - Fr - N1".

(5) Connect the reheat test set to the reheat control amplifier.

(6) Depress the "TEST IND. LIGHTS" test set push-button and check that all the indicating lights illuminate.

(7) Switch On "TEST SET ON/OFF" for supply and check that "28 V - 115 V - PURGE CLOSED" indicating lights illuminate.

(8) Switch On "Ttl - Fe - Fr - N1".

(9) Place the A.C. selector in position "MOTOR CONT.".

(10) Adjust Nl to a value equal to or less than 1000 Hz.

(11) Adjust Fr to 55 Hz.

(12) Adjust Fe to 100 Hz.

(13) Adjust Ttl to 5.8 volts.

C. Check of light-up sequences (Ref. Fig. 505)

(1) Move progressively throttle lever forward and check that "ALPHA 10%" indicating light goes on when throttle lever is moved by 2 degrees approx.

(2) Increase progressively N1 until "90%" indicating light goes On. The N1 value must be between 3435 and 3470 Hz.

(3) Check that "90% - METERING VALVE OPEN - SAFETY RELAY S.O.V.S." indicating lights go On simultaneously.

(4) Check the light-up sequences by observing the test set indicating lights and checking for existing tacho gene output voltage on the digital voltmeter.

NOTE: Lighting up and extinction of indicating light sequences are shown in illustration
R (Ref. Fig. 505).

(5) Observe spark flickering in reheat ignition prechamber.

R D. Check of "Fr light-up" (Ref. Fig. 505).

(1) Switch Off "REHEAT" at pilot station and check that "METERING VALVE CLOSED" goes On.

(2) Check for existing tacho gene output voltage.

(3) Check that "PURGE SOLENOID" light goes On after period of 5 seconds starting from reheat stop order.

(4) Decrease Fr simulation by 5 Hz.

(5) Switch On "REHEAT" at pilot station.

(6) Check that light-up sequences are the same as detailed in para. C.

(7) Read metering valve motor control voltage. Should be higher than 5 volts.

R E. Check of Flame Detection (Ref. Fig. 506).

(1) Switch On "SIMULATED FLAME DETECTOR".

(2) Check that "FLAME DETECTION" indicating light goes On.

COCKPIT AND TEST SET PREPARATION | CHECK OF LIGHT-UP SEQUENCES | CHECK OF "Fr LIGHT-UP"

COCKPIT
- THROTTLE LEVER POSITION
- REHEAT CONTROL SWITCH

THROTTLE LEVER MOVED BY 2 DEGREES

TEST SET INCATING LIGHTS
- 28 V
- 115 V
- REHEAT ON
- CONTINGENCY
- FLIGHT
- ALPHA 10 %
- 90 %
- METERING VALVE "OPEN/CLOSED"
- SAFETY RELAY
- S.O.V.S
- PURGE CLOSED
- PURGE SOLENOID
- IGNITION RELAY (I.R)
- FAULT
- FLAME DETECTION
- AUTOM.STOP
- TRANSF. ENERG.

28 V
115 V
10 %
90 %
OPEN
CLOSED
OPEN

CONNECT TEST SET TO REHEAT CONTROL AMPLIFIER

INCREASE PROGRESSIVELY N1.
AT OBTENTION OF "90 %"
READ CORRESPONDING N1 VALUE

SIMULATION
- N1
- Fr
- Fe
- Ttl
- FLAME

N1 ≤ 1000 Hz
55 Hz
100 Hz
5.1 V

DIGITAL MEASURING
- Ttl
- Fr or Fe
- READ Fr/Fe PROG.
- READ Fr LIGHT-UP PROGR.
- READ Fe
- U TACHO GENE

CHECK FOR EXISTING TACHO GENE VOLTAGE OUTPUT (SHORT DURATION)

D.C POINTER VOLTMETER
A.C POINTER VOLTMETER

READ U MOTOR (<2 V)
READ U MOTOR (>5V)

TEST SET SWITCHES
- MAN/AUTO/DYN
- TEST SET "ON/OFF" (Supply)
- INDICATING LIGHTS TEST
- A.C SELECTOR POSITION
- D.C SELECTOR POSITION
- Ttl
- Fe
- Fr
- N1

MAN
METERING VALVE MOTOR CONTROL
TEST
ON
ON
ON
ON

CMS 76 15 00 5 CAMO

R

Basic Check in Manual Mode
Figure 505

CHECK OF FLAME DETECTION

CHECK OF Fr/Fe VERSUS Ttl PROGRAMME

COCKPIT
THROTTLE LEVER POSITION
REHEAT CONTROL SWITCH

TEST SET INCATING LIGHTS
28 V
115 V
REHEAT ON
CONTINGENCY
FLIGHT
ALPHA 10 %
90 %
METERING VALVE "OPEN/CLOSED"
SAFETY RELAY
S.O.V.S
PURGE CLOSED
PURGE SOLENOID
IGNITION RELAY (I.R)
FAULT
FLAME DETECTION
AUTOM.STOP
TRANSF. ENERG.

SIMULATION
N1
Fr
Fe
Ttl
FLAME

DIGITAL MEASURING
Ttl
Fr or Fe
READ Fr/Fe PROG.
READ Fr LIGHT-UP PROGR.
READ Fe
U TACHO GENE
D.C POINTER VOLTMETER
A.C POINTER VOLTMETER

TEST SET SWITCHES
MAN/AUTO/DYN
TEST SET "ON/OFF" (Supply)
INDICATING LIGHTS TEST
A.C SELECTOR POSITION
D.C SELECTOR POSITION

TEST SET
Ttl
Fe
Fr
N1

Continued from Figure 505

EXTINCTION

CLOSED

OPEN

ADJUST Fr FOR U MOTOR <2 V

INCREASE Fr BY 5Hz

DECREASE Fr BY 5 Hz

4.2 V

FLAME

ADJUST Ttl RELATED TO SECOND POINT OF PROGRAMME Fr/Fe AND REPEAT OPERATIONS

U MOTOR <2V

U MOTOR >5V

U MOTOR >5V

Ttl

Continued on figure 507

CMS 76 15 00 5 DAMO

Basic Check in Manual Mode
Figure 506

R

F. Check of Fr/Fe Versus Tt1 Programme.

(1) Adjust Fe to 100 Hz and Tt1 to 5.1 V.

(2) Adjust Fr so as to obtain the metering valve motor control voltage to be less than 2 volts and check that "METERING VALVE OPEN" indicating light extinguishes.

(3) Check that Fr value is satisfactory.

(a) Take-Off Fr should be 78 Hz plus or minus 1 Hz.

(b) Flight Fr should be 60 Hz plus or minus 1 Hz.

(c) Contingency Fr should be 90 Hz plus or minus 1 Hz.

(4) Increase Fr by 5 Hz and check that "METERING VALVE CLOSED" goes on and that "METERING VALVE OPEN" goes off.

(5) Decrease Fr by 5 Hz. Check that "METERING VALVE CLOSED" goes Off and that "METERING VALVE OPEN" goes On.

(6) Adjust Tt1 to 4.2 volts and repeat checks previously carried out in operations (2 and 3). Fr with any programme should be 30 Hz plus or minus 2Hz.

G. Ttl Failure Safety Check (Ref. Fig. 507)

(1) Switch Off "Ttl".

(2) Check for zero voltage on the relevant digital voltmeter.

(3) Check that "METERING VALVE CLOSED" indicating light illuminates.

(4) Decrease Fr to obtain extinction of "METERING VALVE CLOSED".

(5) Check that Fr/Fe is in accordance with bit zero of reheat control amplifier programmed law selected.

(a) Fr/Fe for Take-Off must be 0.85 plus or minus 2 per cent.

(b) Fr/Fe for Flight must be 0.30 plus or minus 2 per cent.

(c) Fr/Fe for Contingency must be 0.90 plus or minus 2 per cent.

H. Check Fr Mini (Ref. Fig. 507)

(1) Adjust Fe to Fe mini.

(2) Check that "METERING VALVE CLOSED" indicating light illuminates.

(3) Check that Fr is 16 plus or minus 2 Hz.

(4) Decrease Fr to obtain extinction of "METERING VALVE CLOSED".

I. N1 Failure Safety Check (Ref. Fig. 508)

(1) Decrease progressively N1 for extinction of "90%" then go on until "AUTOM. STOP" illuminates. N1 must be between 3180 and 3213 Hz.

(2) Check that "METERING VALVE CLOSED" illuminates during 15 seconds approx.

(3) Check that "PURGE SOLENOID" light goes On after period of 5 seconds starting from the moment "METERING VALVE CLOSED" light goes On. Check that "PURGE SOLENOID" goes Off after period of 5 seconds.

<u>NOTE</u>: When "FLIGHT" is selected on the "ENG RATING MODE" switch located on the pilot's roof panel the FAULT indicating light goes on at the end of the Reheat shut-off sequences due to the fact that flame simulation is switched on. This function is muted when TAKE OFF is selected.

J. Conclusion (Ref. Fig. 508)

(1) Switch Off "FLAME DETECTOR".

(2) Depress the "TEST IND. LIGHTS" test set push-button. The "AUTOM. STOP" light must extinguish.

(3) Check that only the "28 V - 115 V - ALPHA 10% - PURGE CLOSED - FAULT" lights remain On.

R (4) Switch off the "ON/OFF TEST SET" switch.

R (5) Switch off "REHEAT" at pilot station.

R (6) Position the main throttle lever back to the idle

R

Basic Check in Manual Mode
Figure 507

Basic Check in Manual Mode
Figure 508

R

R position.

(7) Disconnect the reheat test set from reheat control amplifier.

4. Reheat Test Box Use (Ref. Fig. 509)

A. Equipment and Materials

DESCRIPTION	PART NO.
Reheat Test Box	9970-531-044

B. Prepare to carry out the Reheat System Test

WARNING : THE REHEAT FLAME DETECTOR (IONISATION) IS ENERGIZED UNDER 150 V AS LONG AS THE REHEAT CIRCUITS REMAIN ELECTRICALLY SUPPLIED FOR FAULT ISOLATION PURPOSES. FURTHERMORE, THE REHEAT IGNITION HIGH ENERGY VOLTAGE IS POTENTIALLY LETHAL. COMPLY WITH THE SAFETY PRECAUTION DETAILED IN CHAPTER 12. BEFORE CARRYING OUT ANY VISUAL INSPECTION OF AREAS INSIDE THE REHEAT CHAMBER WHICH REQUIRES THE OPERATOR TO COME CLOSE TO THE BUCKETS, MAKE SURE THAT NO SOURCE OF COMPRESSED AIR IS CONNECTED TO THE GROUND AIR CONNECTORS OF THE TWIN SECONDARY NOZZLE.

CAUTION: THE REHEAT TEST BOX MUST BE USED FOR STATIC CHECKS ONLY, ENGINE SHUT DOWN. IT MUST BE DISCONNECTED FROM THE REHEAT CONTROL AMPLIFIER AT THE END OF THE TEST.

(1) Position the main throttle lever fully forward.

(2) Switch on the REHEAT switch at pilot station.

(3) Ensure that the reheat system supply circuit breakers are set (Ref. Table 503).

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
ENGINE No. 1			

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
REHEAT CONT	15-216	1K1542	E 9
REHEAT AMP SUP	14-215	1K1541	C12
REHEAT IGN SUP PH A	14-215	1K1543	B13
REHEAT IGN SUP PH C	14-215	1K1544	F12
ENGINE No. 2			
REHEAT CONT	15-215	2K1542	D15
REHEAT AMP SUP	13-215	2K1541	B14
REHEAT IGN SUP PH A	13-215	2K1543	A14
REHEAT IGN SUP PH C	13-215	2K1544	E14
ENGINE No. 3			
REHEAT CONT	15-215	3K1542	D16
REHEAT AMP SUP	13-216	3K1541	B 7
REHEAT IGN SUP PH A	13-216	3K1543	A 5
REHEAT IGN SUP PH C	13-216	3K1544	F 6
ENGINE No.4			
REHEAT AMP SUP	15-216	4K1542	E10
REHEAT AMP SUP	14-216	4K1541	D 7
REHEAT IGN SUP PH A	14-216	4K1543	A 6
REHEAT IGN SUP PH C	14-216	4K1544	E 7

Circuit Breakers
Table 503

C. Connect the Reheat Test Box to the Reheat Control Amplifier

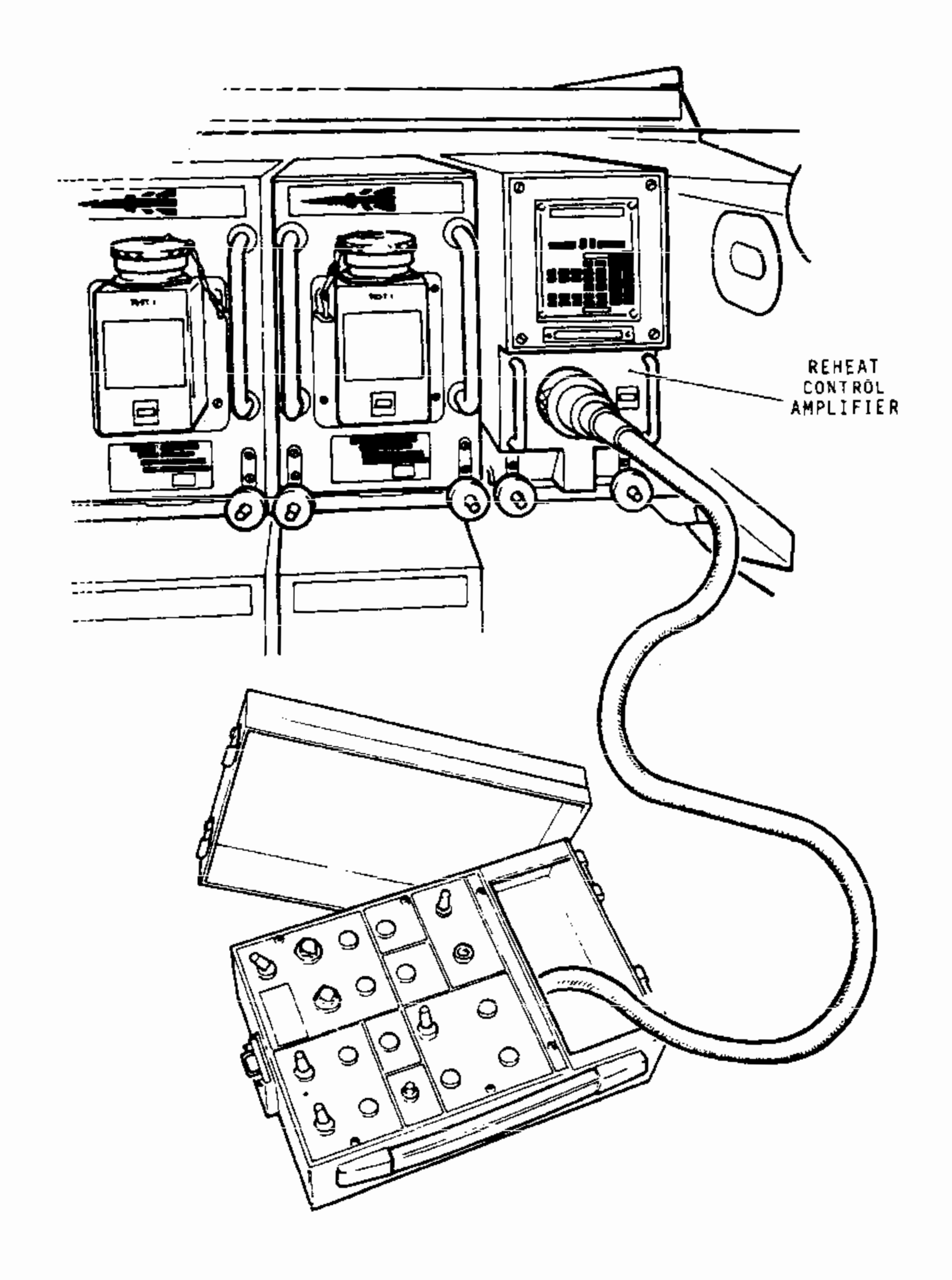
(1) Check that all the test box switches are set to OFF.

(2) Connect the test box to the reheat control amplifier test connector

(3) Switch on the test box power supply switch and check that the 28 V DC, 115 V/400 Hz and ALPHA 10% THROTTLE LEVER lights illuminate.

(4) Depress the test box LIGHT TEST push-button and check that all the test box lights illuminate.

D. Reheat Ignition Operation Check



Reheat Test Box Connected to Reheat Control Amplifier
Figure 509

R

(1) Switch ON Fr and check that the relevant indicator light illuminates.

(2) Switch on N1 and check that :

a) N1 and REHEAT IGNITION TRANSFORMER SUPPLY lights illuminate.

NOTE: The REHEAT IGNITION TRANSFORMER supply indicator light is only illuminated during the reheat ignition sequence.

b) Reheat igniter operates by observing the spark flickering in the reheat ignition prechamber.

(3) Switch off N1 and Fr and check that the relevant lights extinguish.

E. Reheat Fuel Control System Operation Check.

(1) Switch on Fr and check that the relevant light illuminates.

(2) Switch on N1 and check that the shut-off VALVE ENERGIZING indicator light and N1 light illuminate.

(3) Check the operation of the reheat metering valve by observing the REHEAT THROTTLE MOTOR indicator lights when actuating the Fe GENERATOR switch :

(a) Switch on Fe GENERATOR and check that the OPENING indicator light illuminates (short duration).

(b) Switch off Fe GENERATOR and check that the CLOSING indicator light illuminates (short duration).

(4) Switch off N1 and Fr and check that the relevant lights extinguish.

F. Fe and Fr lines integrity test

(1) Flip the test switch to Fr and then to Fe and check that the LINE INTEGRITY TEST light illuminates.

G. Conclusion

(1) Switch off all test box switches

(2) Switch off the reheat switch at the pilot station

(3) Position the main throttle lever back to the idle position.

(4) Disconnect the test box from the reheat control amplifier.

REHEAT FLAME DETECTOR - REMOVAL/INSTALLATION

1. Tools and Equipment

   Circuit breaker safety clip ... ... -

2. Reheat Flame Detector (Ref. Fig. 401)

   A. Prepare to Remove Reheat Flame Detector.

      (1) Engines No.1 and No.3, open engine bay rear doors (Ref. 71-00-00, Servicing).

      (2) Engines No.2 and No.4, open engine bay rear lower door (Ref. 71-00-00, Servicing).

      (3) Electrically isolate the engine additional services indicated in Table 401 by tripping the circuit breakers affecting the engine upon which work is to be carried out. Attach safety clips.

	SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
	Engine No.1			
R	REHEAT AMP SUP	14-215	1K1541	C12
R	REHEAT CONT	15-216	1K1542	E9
	Engine No.2			
R	REHEAT AMP SUP	13-215	2K1541	B14
R	REHEAT CONT	15-215	2K1542	D15
	Engine No.3			
R	REHEAT AMP SUP	13-216	3K1541	B7
R	REHEAT CONT	15-215	3K1542	D16
	Engine No.4			
R	REHEAT AMP SUP	14-216	4K1541	D7
R	REHEAT CONT	15-216	4K1542	E10

Circuit Breakers
Table 401

CR 31303/00E

A B C

ELECTRICAL LEAD

RECEPTACLE

CONDUCTOR

A

BRACKET

COMBUSTION CHAMBER OUTER CASE REAR FLANGE

BRACKET

VENT TUBE ELBOW

B

C

REHEAT FLAME DETECTOR

SPHERICAL JOINT FLANGE

PRE S.B.77-11

C

REHEAT FLAME DETECTOR

SPHERICAL JOINT FLANGE

S.B.77-11

CMR 76 15 02 4 AAM0

Reheat Flame Detector
Figure 401

R

B. Remove Reheat Flame Detector.

CAUTION: TAKE CARE NOT TO BEND REHEAT FLAME DETECTOR CONDUCTOR AT ANY TIME. BENDING COULD RESULT IN DETERIORATION OF CONDUCTOR INSULATION.

(1) Disconnect electrical lead end plug from reheat flame detector conductor receptacle at bracket located on combustion chamber outer case rear flange.

(2) Remove two nuts and bolts securing flame detector conductor to bracket at combustion chamber outer case rear flange.

(3) Remove nut, washer and bolt and detach flame detector conductor clamp from bracket at vent tube elbow.

(4) On engines to pre S.B.OL.593-77-10 and 77-11 standard, support flame detector, remove the four securing bolts and withdraw detector from spherical joint flange.

(5) On engines to S.B.OL.593-77-10 and 77-11 standard, slacken pitot tube clamp assembly bolt and four bolts securing flame detector. Support detector, remove securing bolts and move pitot tube bracket clear of flange, then withdraw detector.

C. Install Reheat Flame Detector.

(1) Apply lubricant S (Ref. 70-00-01, Servicing and Storage Materials) to flange attachment bolts.

CAUTION: TAKE CARE NOT TO BEND REHEAT FLAME DETECTOR CONDUCTOR AT ANY TIME. BENDING COULD RESULT IN DETERIORATION OF CONDUCTOR INSULATION.

(2) On engines to pre S.B.OL.593-77-10 and 77-11 standard, assemble reheat flame detector to spherical joint
R flange and retain with four bolts lightly tightened.

(3) On engines to S.B.OL.593-77-10 and 77-11 standard, align pitot tube clamp assembly and bracket to
R flange and retain with four bolts lightly tightened.

(4) Torque-tighten four bolts at spherical joint flange (Pre. or S.B.OL.593-77-10 and 77-11 standard) to (12 ± 2 N.m) (105 ± 18 lbf in.). Wire-lock bolts in pairs.

(5) Torque-tighten pitot tube clamp assembly (S.B.OL.

R 593-77-10 and 77-11 standard) to 100 lbf in. (11,5 N.m)
R with lubricant A applied.

(6) Secure flame detector conductor receptacle to bracket on combustion chamber outer case rear flange, with two bolts and nuts torque-tightened to between 85 and 95 lbf in. (9,6 and 10,7 N.m) with lubricant B applied.

(7) Ensure that the distance between the reheat flame detector and the flame holder is within the limits detailed in 76-15-02, Inspection/Check.

(8) Secure flame detector clamp to bracket at vent tube elbow with a bolt, washer and nut torque-tightened to between 67 and 73 lbf in. (7,6 and 8,2 N.m) with lubricant B applied.

(9) Connect electrical lead end plug.

(a) Connect electrical lead end plug to reheat flame detector conductor receptacle.

(b) On engines to pre S.B.OL.593-71-15 standard, connect, tighten and wire-lock lead end plug. On engines to S.B.OL.593-71-15 standard, connect, tighten and indicate final tightened position with a white line painted across the connection join.

D. Complete the Installation.

(1) Reset circuit breakers (Ref. Table 401).

(2) On completion of work, close engine bay doors (Ref. 71-00-00, Servicing).

REHEAT FLAME DETECTOR - INSPECTION/CHECK

1. General

A dimensional check of a reheat flame detector is required after installation and when Trouble Shooting.

It is necessary to enter the jet pipe in order to carry out the check.

2. Flame Detector (Ref. Fig. 601)

A. Prepare Jet Pipe for Entry.

(1) Carry out the safety precautions and work sequences required for access to the jet pipe as detailed in 71-00-00, Servicing.

B. Flame Detector Check.

(1) Enter jet pipe, measure and record dimension X as shown in the illustration (Ref. Fig. 601).

(2) The measurement recorded must be within the limits given to be acceptable.

C. Complete Check Procedure.

(1) Remove servicing equipment installed in the jet pipe for access complying fully with the procedure detailed in 71-00-00, Servicing.

CR 31869/00A

FLAME HOLDER

60mm ± 18mm
(2·35 IN ± 0·71 IN)

REHEAT FLAME DETECTOR

EXHAUST DIFFUSER

SPHERICAL JOINT FLANGE

CMR 76 15 02 6 AAMO

Reheat Flame Detector Check Details
Figure 601

REHEAT DETECTION PRESSURE SWITCH - ADJUSTMENT/TEST

1. General

The reheat detection pressure switch function is to indicate if reheat operates properly by sensing the differences between two pressures. When the differences between the high pressure and the low pressure systems reach a pre-determined value of increasing differential pressure, the capsule housed inside the unit operates and closes an electrical contact which initiates a warning circuit.
The operational test described in this topic is complementary to the removal/installation of the reheat detection pressure switch and is also used to check this unit for correct operation when trouble-shooting the reheat system.

R B Many instances have occurred of the "Reheat Fault Light"
R B illuminating on take-off after the reheat has been selected
R B off. This is possibly due to the Flight Engineer selecting the
R B engine rating switch to "Flight" too soon after the reheat is
R B switched off. At least 15 seconds should be allowed between
R B the two selections.

R B If the reheat fault light illuminates after reheat is selected
R B off and it is not associated with any other engine malfunction,
R B no maintenance action should be taken.

R B NOTE: This applies to take-off only and not transonic
R B acceleration.

R B The fault light can be extinguished by recycling the "Reheat
R B Cont" and "Reheat Amp Sup" circuit breakers for the appropriate
R B engine.

2. Reheat Detection Pressure Switch - Operational Test

A. Equipment and Materials

DESCRIPTION	PART NO.
Reheat detection pressure switch test set	SNECMA 9970-531-033
Circuit breaker safety clips	-

B. Prepare to Test Reheat Detection Pressure Switch.

(1) Electrically isolate the engine and exhaust assembly services indicated in Table 501 by tripping the circuit breakers affecting engines in the nacelle upon which work is being carried out. Fit circuit breaker safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
Engine NO.1			
MAIN THROT SUP.	2-213	1K1	F12
% AREA (AJ) IND.	14-215	1E81	C13
ENG VIBRATION IND SUP. 1	4-213	E512	C18
ENG VIBRATION IND SUP. 2	4-213	E513	D18
REHEAT CONT.	15-216	1K1542	E 9
REHEAT AMP. SUP.	14-215	1K1541	C12
Engine NO.2			
MAIN THROT SUP.	2-213	2K1	C12
% AREA (AJ) IND.	13-215	2E81	D13
ENG VIBRATION IND SUP. 1	4-213	E512	C18
ENG VIBRATION IND SUP. 2	4-213	E513	D18
REHEAT CONT.	15-215	2K1542	D15
REHEAT AMP. SUP.	13-215	2K1541	B14
Engine NO.3			
MAIN THROT SUP.	2-213	3K1	C13
% AREA (AJ) IND.	13-216	3E81	B 6
ENG VIBRATION IND SUP. 1	4-213	E512	C18
ENG VIBRATION IND SUP. 2	4-213	E513	D18
REHEAT CONT.	15-215	3K1542	D16
REHEAT AMP. SUP.	13-216	3K1541	B 7
Engine NO.4			
MAIN THROT SUP.	2-213	4K1	F13
% AREA (AJ) IND.	14-216	4E81	B 6
ENG VIBRATION IND SUP. 1	4-213	E512	C18
ENG VIBRATION IND SUP. 2	4-213	E513	D18
REHEAT CONT.	15-216	4K1542	E10
REHEAT AMP. SUP.	14-216	4K1541	D 7

Circuit Breakers
Table 501

(2) Display a suitable placard on the engine starting panel, indicating that personnel are working on the engines and the twin secondary nozzle area.

(3) Open the appropriate engine access door.

C. Install Reheat Detection Pressure Switch Test Set (Ref. Fig. 501)

CAUTION: HANDLE WITH CARE THIS TEST SET AS IT FEATURES A VERY FINE MEASURING INSTRUMENT.

(1) Remove the cover of the test set.

(2) Check the "zeroing" of the vacuum gauge. If this adjustment needed to be done, proceed as follows :

(a) Remove the four plate attachment screws

(b) Remove carefully the plate

(c) Adjust to zero the vacuum gauge using the knurled knob located at the back of the vacuum gauge.

NOTE: This adjustment must be done with the vacuum gauge in horizontal position.

(d) Reinstall the plate and secure it.

(3) Disconnect the plug from the reheat detection pressure switch and connect the test set angle plug.

(4) Connect the straight connector to the relevant test set receptacle.

(5) Connect the power supply 115-400 Hz to the test set.

(6) Check the test set electrical circuit : the indicator light should illuminate when depressing the test push-button.

(7) Place the pneumatic selector on "Measuring" position.

(8) Get into the jet pipe.

(9) If necessary, clean the static pressure tapping holes located, respectively, in the sperhical flange adaptor and rear end of the primary nozzle (Ref. Fig. 502).

D. Test Reheat Detection Pressure Switch.

NOTE: Procedure detailed hereafter applies to reheat detection pressure switch installed in the nacelle. If test is carried out with pressure switch removed from aircraft, install and torque 5 shop bolts to replace those used for nacelle installation.

(1) Insert the air hose endpiece into the spherical flange adaptor static pressure tapping hole and hold the va-

COVER
ELECTRICAL CABLE
STRAIGHT PLUG
ANGLE PLUG
INDICATOR LIGHT
INDICATOR LIGHT TEST PUSH-BUTTON
PNEUMATIC SELECTOR
VACUUM GAUGE
PLATE ATTACHMENT SCREW
TEST SET CONNECTOR
TEST SET POWER SUPPLY CONNECTOR
PUMP CRANK
BLANKING PLUG
VACUUM CUP
AIR HOSE

CMS 76 15 03 15 AAM0

Reheat Detection Pressure Switch Test Set
Figure 501

cuum cup in position.

(2) Turn clockwise the pump crank until the indicator light illuminates and check that the pressure indicated on the vacuum gauge is between 105 and 175 millibars (1.50 psi and 2.50 psi).

(3) Remove the air hose endpiece from the spherical flange adaptor and insert it into the primary nozzle rear end static pressure tapping hole.

(4) Turn anti-clockwise the pump crank until the indicator light illuminates and check that the negative pressure shown on the vacuum gauge is between 105 and 175 millibars (1.50 psi and 2.50 psi).

NOTE: If it is not possible to reach the desired pressure or negative pressure levels through a single pump crank operation, proceed as follows :

(a) When the pump piston is against the end of travel stop and without removing the air hose endpiece from the static pressure tapping hole, place quickly the pneumatic selector on "Breather" position.

(b) Bring back the pump piston against the opposite stop.

(c) Replace the pneumatic selector on the "Measuring" position : the vacuum gauge then indicates the residual pressure or negative pressure which has been "trapped" in tubing external to the test set.

(d) Repeat above steps as many times as necessary until obtention of the pressure level required for operation of the reheat detection pressure switch.

E. Conclusion

(1) Remove the air hose endpiece from the primary nozzle rear end static pressure tapping hole.

(2) Disconnect the test set power supply.

(3) Disconnect the test set angle connector and reconnect the reheat detection pressure switch connector.

REHEAT DETECTION PRESSURE SWITCH

PRIMARY NOZZLE STATIC PRESSURE TAPPING HOLE

SPHERICAL FLANGE ADAPTOR STATIC PRESSURE TAPPING HOLE

CMS 76 15 03 5 BAMO

Reheat Detection Pressure Switch - Static Pressure Tapping Holes Location
Figure 502

(4) Shut the appropriate engine access door.

(5) Remove the safety clips and reset all circuit breakers (Ref. Table 501).

REHEAT CONTROL AMPLIFIER - DESCRIPTION AND OPERATION

1. General

The reheat control consists of scheduling the reheat fuel flow (FR) according to the basic engine operating conditions and also depending on flight conditions. This is achieved by the reheat control amplifier. This unit, installed in the eletronic bay at the rear of the fuselage, elaborates the reheat operating sequences, the computation of the reference fuel flow and controls the different components.

2. Description (Ref. Fig. 001)

The reheat control amplifier consists of a rectangular-shaped light alloy casing comprising a central unit the ends of which are fitted with a front unit and a rear unit. The front unit features a test connector used when testing the reheat system, including the amplifier, and a pulse counter for reheat ignition operation recording. Two hooks, at the lower part of the front unit, provide for attachment of the amplifier when installed in its rack, the removal being facilitated by two handles located on each side of the test connector.

The rear unit incorporates a single DPX connector supplying the amplifier with its electrical requirements (115 V - 400 Hz and 28 VDC) as well as allowing the routing of all the input and output signals related to the reheat control function.

An upper cover gives access to the printed circuit card assembly and the power supply unit which are housed inside the central unit.

3. Functions Performed (Ref. Fig. 002)

A. Input Signals

When reheat is selected, the reheat control amplifier processes different input signals and controls the different reheat system components. The input signals are as follows:

(1) Pilot's throttle lever position.

(2) Reheat selection.

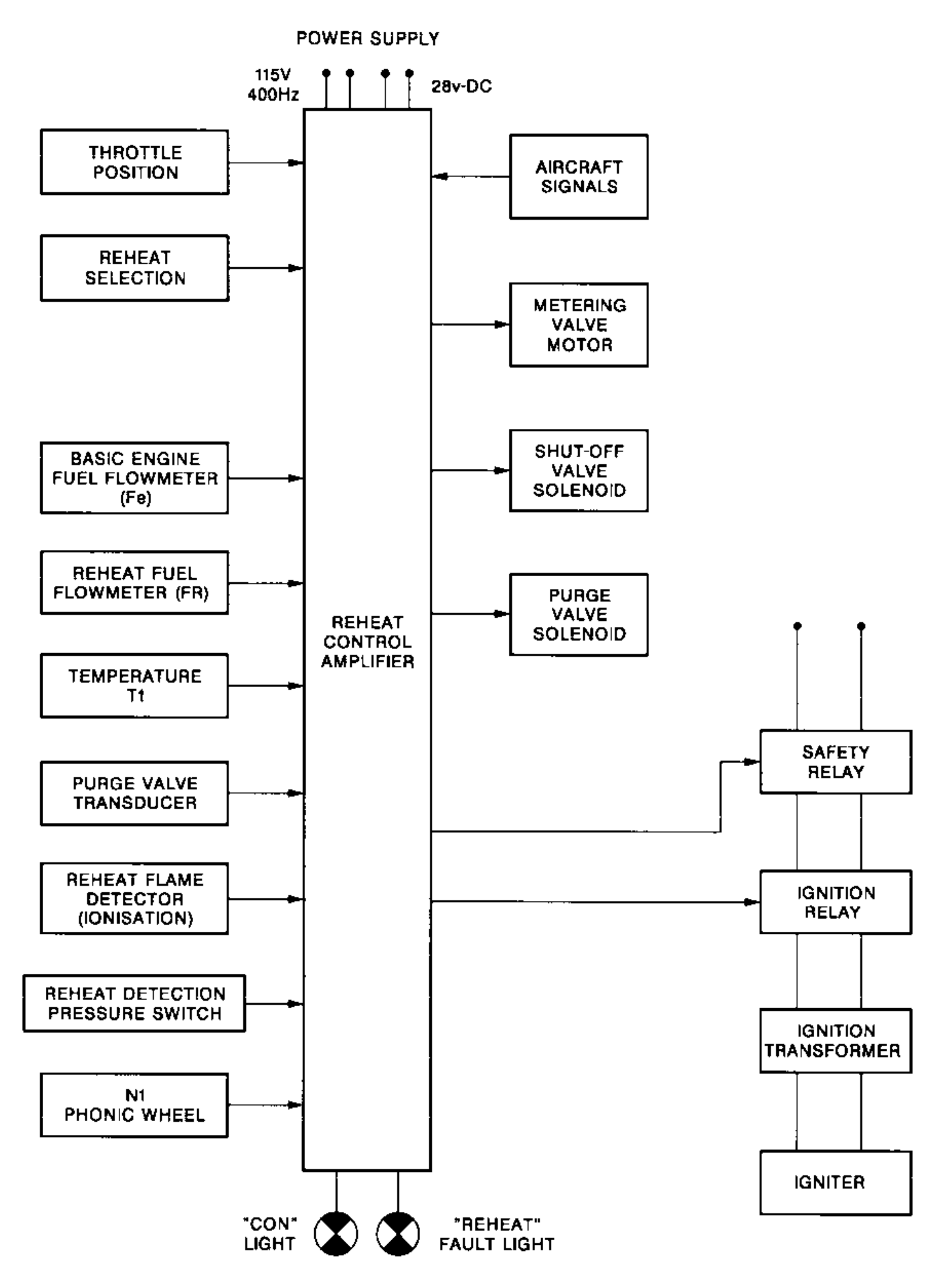
(3) Basic engine fuel flowmeter (Fe).

(4) Reheat fuel flowmeter (FR).

(5) T1 temperature.

UPPER COVER
PRINTED CIRCUIT CARD ASSEMBLY
REAR UNIT
HANDLE
DPX CONNECTOR
POWER SUPPLY UNIT
TEST CONNECTOR
CENTRAL UNIT
PULSE COUNTER
FRONT UNIT
ATTACHMENT HOOK
CMS 76 15 11 0 AAM0

Reheat Control Amplifier
Figure 001



CMS 76 15 11 0 BAMD 00

Reheat Control Amplifier - Functions Performed
Figure 002

R

(6) Purge valve transducer.

(7) Reheat flame detector (ionisation) and reheat detection pressure switch.

(8) N1 rotation speed as sensed by the phonic wheel.

(9) Signals from aircraft cockpit "Contingency", "Flight", "Take-off".

B. Output Signals.

The reheat system components controlled by the amplifier are as follows:

(1) Metering valve control motor.

(2) Shut-off valve solenoid.

(3) Purge valve solenoid.

(4) Safety relay.

(5) Ignition relay.

(6) Configuration light (labelled "CON").

(7) Reheat fault light (labelled "REHEAT").

4. General Operation (Ref. Fig. 003)

A. Reheat Selection.

The reheat selection order is given by the reheat control switch and the throttle lever position being higher than or equal to 10%; both these conditions result in:

(1) Energization of the reheat control amplifier.

(2) Zeroing of all the decision elements (logic circuits).

(3) Energization of the safety relay.

(4) Energization of the reheat detector.

R B. Light-up Sequence. (T2)

This sequence takes place only if the reheat selection order has been given and if N1 rotation speed is higher than 81%.

STAND-BY CIRCUITS POWER SUPPLY

AMPLIFIER AND FLAME DETECTOR POWER SUPPLY

SAFETY RELAY ENERGIZED

LIGHT-UP SEQUENCE (TRANSFORMER ENERGIZED) — T2

AUTOMATIC SHUT-OFF AFTER t'2 IF Fr LESS THAN 8Hz — t'2

IGNITION RELAY FAIL SAFE SIGNAL — T7

SHUT-OFF VALVE SOLENOID ENERGIZING

REHEAT OPERATION

METERING VALVE CLOSING — T3

PURGE VALVE SOLENOID ENERGIZING — T4

DELAY ON THE REHEAT FLAME DETECTION MONITORING — T6

REHEAT SELECTED

N1 HIGHER THAN 81 %

REHEAT SHUT-OFF

S 76 15 11 0 CAMO

Reheat Control Amplifier Schematic Operation
Figure 003

R At the starting first pulse of sequence T2 (3.5 seconds approx.) the shut-off valve solenoid is energized, the
R metering valve control motor is supplied so as to move the metering valve towards "opening" and the reheat fuel
R flow is metered as per the light-up schedule FRA versus Fe.

During this sequence, the reheat ignition transformer
R is energized for 3.5 seconds approx. and supplies the reheat igniter with high voltage. The fuel is then ignited.

R C. Operating Sequence.

This sequence starts as soon as T2 is completed. The requisite fuel flow parameter FR results from three schedules which are: "TAKE-OFF", "CONTINGENCY" and "FLIGHT". This flow parameter also allows for the following limitations:

(1) Limitation of the minimum reheat fuel flow FR Min.

(2) Limitation of the total fuel flow FT.

R D. Shut-off Sequence.

The reheat shut-off is obtaineds either manually through the reheat control switch or the throttle lever or automatically, consecutively to a (N1) speed drop.

(1) Manual shut-off.

When reheat is switched "OFF" or when the throttle lever is moved to a position lower than 10%, the following results:

(a) Interruption of the light-up sequence (T2) if it is not completed.

(b) Starting of the metering valve closing sequence (T3).

(c) The cutting-off, at the end of T3, of all the electrical supply circuits except the stand-by circuits.

(2) Automatic shut-off.

If N1 speed decreases down to a level less than 75% the reheat is automatically shut-off. In this occurrence, the sequence T2 stops by itself if it is not completed and sequence T3 begins.

R E. Purge Sequence (T4).

Any shut down of the reheat operating sequence results in:

(1) Closing of the metering valve.

(2) De-energizing of the shut-off valve solenoid and closing of the shut-off valve.

(3) Energizing of the purge valve solenoid.

NOTE: Between the end of sequence T4 and the end of sequence T3, reheat flame detection is monitored. To avoid spurious flame detection resulting from the purge it has been necessary to delay this monitoring (Sequence T6 = 2 secs, starting at the end of T4).

R F. Reheat Re-selection.

(1) The reheat has been shut-off by the reheat control switch:

The reheat may be relit only if the reheat control switch is set to "ON". In this case, sequence T2 begins as soon as N1 speed is higher than 81%. The starting of sequence T2 stops immediately sequence T3 if the latter is not completed.

(2) The reheat has been shut-off by the throttle lever or by a drop in N1 speed: the reheat relights as soon as N1 speed is higher than 81%.

(3) The reheat has been shut-off by an automatic shut-off: the reheat will relight when the reheat control switch is set to "OFF", then to "ON".

R G. Safety Circuits.

The safety circuits sense the operating malfunctions and act in the following manner:

(1) Safety relay.

The safety relay is energized between the reheat selection order and the beginning of sequence T3.

If a reheat shut-off occurs due to a drop in N1 speed, it remains energized even after completion

of T3. If the reheat ignition relay contact blades remain(s) closed after sequence T7, the reheat control amplifier de-energizes the safety relay.

(2) Reheat automatic shut-off occurrences.

The reheat is automatically shut-off when the following conditions occur:

R (a) Interruption of the a.c. power supply for a
R duration longer than T5.

R NOTE: T5 is a time of interval of 1 min
R 25 sec. approx. during which
R momentary interruption of the 115V
R a.c. supply is acceptable with no
R consequence on the reheat operation.

(b) Short-circuit affecting the shut-off valve solenoid.

(c) Grounding of the metering valve control motor reference phase.

(d) Short-circuit affecting the energizing circuit of the reheat ignition relay.

(e) Loss of signal FR from the reheat fuel flow-meter.

NOTE: With the exception of the metering valve control motor reference phase grounding, condition which causes the immediate cutting off of the amplifier electrical supplies (except the stand-by circuits), sequences taking place after automatic shut-off of the reheat, are identical to those prevailing for a manual shut-off.

(3) "REHEAT" fault light.

The conditions causing the fault light to illuminate are summarized in Table 1.

(4) "CON" light (configuration).

This light illuminates when there is no reheat flame detection consecutively to T7, and upon each reheat automatic shut-off with the exception of a reheat shut-off due to N1 speed drop and short-circuit

affecting the metering valve control motor reference phase. The "CON" light normally goes off at completion of sequence T3.

FAULT	LIGHT "ILLUMINATES"	LIGHT "EXTINGUISHES"
Purge valve open after T3	Immediate	If the fault disappears or if reheat is re-selected
Short-circuit affecting the purge valve solenoid	During T4	After T3 or if reheat is re-selected
Ignition relay still energized after T7	At the end of T3	Latch *
Short-circuit affecting R the safety relay and/or R the ignition relay	Immediate	Latch *
Grounding of the metering valve control motor reference phase	Immediate	Latch *
Loss of FR signal after t'2	Immediate	Latch *
Reheat flame detected between the end of T6 and and the end of T3 (This function is muted when Take-off rating is selected.	Immediate	Latch *
Short-circuit affecting the shut-off valve solenoid	Immediate	If reheat control switch is set to OFF, or after T3 if the switch was set to ON position

* The light will extinguish after tripping and resetting the 28V DC and 115-400 Hz breaker.

Conditions Causing the "REHEAT" Fault Light to Illuminate
Table 1

REHEAT CONTROL AMPLIFIER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00

1. General

The reheat control amplifiers are secured in 3/8 ATR long cases in the rear vestibule electrical racking.

2. Amplifier

A. Equipment and Materials

DESCRIPTION	PART NO.
R Circuit breaker safety clips	

B. Prepare

(1) Trip the appropriate circuit breakers and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No. 1			
R ENG 1 REHEAT AMP SUP	14-215	1K1541	C12
ENG 1 REHEAT IGNITION SUP PHA	14-215	1K1543	B13
ENGINE 1 REHEAT IGNITION SUP PHC	14-215	1K1544	E12
ENG 1 REHEAT CONT	15-216	1K1542	E 9
Engine No. 2			
ENG 2 REHEAT CONT	15-215	2K1542	D15
ENG 2 REHEAT AMP SUP	13-216	2K1541	B14
ENG 2 REHEAT IGNITION SUP PHA	13-215	2K1543	A14
ENG 2 REHEAT IGNITION SUP PHC	13-215	2K1544	#14
Engine No. 3			
ENG 3 REHEAT CONT	15-215	3K1542	D16
ENG 3 REHEAT AMP SUP	13-216	3K1541	B 7
ENG 3 REHEAT IGNITION			

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
SUP PHA	13-216	3K1543	A 5
ENG 3 REHEAT IGNITION SUP PHC	13-216	3K1544	E 6
Engine No. 4			
ENG 4 REHEAT CONT	15-216	4K1542	E10
ENG 4 REHEAT AMP SUP	14-216	4K1541	D 7
ENG 4 REHEAT IGNITION SUP PHA	13-216	4K1543	A 6
ENG 4 REHEAT IGNITION SUP PHC	13-216	4K1544	E 7

(2) Enter the rear vestibule and locate the rack assembly.

(3) Remove the cover from the rack assembly and locate the amplifier:

ENGINE NO	RACK	ENGRAVING
No. 1	3-243	1K-1553 REHEAT No 1
No. 2	4-243	2K-1553 REHEAT No 2
No. 3	4-244	3K-1553 REHEAT No 3
No. 4	6-244	4K-1553 REHEAT No 4

C. Remove

(1) Slacken the knurled screws.

(2) Withdraw the amplifier, using the handle, and remove it from the rack.

D. Prepare to Install

(1) Comply with the electrical safety precautions.

(2) Ensure that the racking is clean, and the electrical connector is undamaged.

(3) Check that the connecting pins, on the amplifier, are clean and undamaged.

E. Install

(1) Engage the amplifier with the racking, slide the unit firmly into position and tighten the knurled securing screws.

(2) Check that the amplifier is firmly bonded in accordance with 20-27-11.

F. Conclusion

(1) Refit the cover to the shelf assembly.

(2) Remove the safety clips and reset the circuit breakers previously tripped.

(3) Carry out test of the reheat control system using the Reheat Test Set in Manual Mode (Ref.76-15-00, Adjustment/Test).

FORWARD THRUST THROTTLE SWITCH PACKS - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN CHAPTER 24-00-00.

1. General

The four forward thrust switch packs are mounted in pairs at each side of the centre console support casting. Switch packs No.1 and 2 are positioned on the left side of the console, No.3 and 4 switch packs on the right side of the console. The shaft of each switch pack engages with its respective throttle lever assembly. The switch packs are complete with flying leads.

2. Forward Thrust Throttle Switch Packs

A. Equipment and Materials.

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Tool contact, insertion-extraction	NAS1664-20
Droop nose uplock safety pins (2)	D92-5188-002
Torque spanner, range 0-120 lbf in (0-1.34 mdaN)	-
Crimping tool - Erma-Buchanan	610692
Vidaflex	BA-7857-M017-C
PTFE tape	BAS 8080-29
Locking wire 0.031 in (0.8 mm) dia	DTD189

B. Prepare to Remove Throttle Switch Packs (Ref. Fig. 401)

(1) Electrically isolate the relevant services in the centre console by tripping the circuit breakers and securing them with safety clips.

NOTE: For electrical isolation, the following circuit breakers for Auto-Throttle, Air Conditioning, Landing Gear, Visor and Droop Nose and Floor Lights must be tripped in addition to those for the appropriate switch pack.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
AFCS 1 CONT	1-213	1C19	Q14
AT 1 CONT	1-213	1C180	Q12
AFCS 2 CONT	5-213	2C19	A12
AT 2 CONT	5-213	2C180	A14
SYS 1 GRND PRESSN CONT	15-215	H1157	E 3
SYS 1 DITCHING VALVE CONT	1-213	H1149	G13
SYS 1 FWD & AFT DISCHARGE VALVE SUP	5-213	H1125	E 8
SYS 1 GRND PRESSN CONT	15-216	H1158	D23
SYS 2 DITCHING VALVE CONT	1-213	H1150	F10
SYS 2 FWD & AFT DISCHARGE VALVE SUP	1-213	H1124	E13
CABIN OVER PRESS IND	5-213	H1126	E 9
AUDIO WARN SYS SUP 1	1-213	W371	M21
AUDIO WARN O/SPEED SUP 1	1-213	W374	S19
AUDIO WARN SYS SUP 2	5-213	W372	C17
AUDIO WARN O/SPEED SUP 2	5-213	W373	C18
NOSE 7 1/2° CONT	1-213	M12	Q16
VISOR & NOSE CONT	15-215	M11	F 8
NOSE/VISOR STBY LOWER SUP	1-213	M13	Q17
CHARTS STOWAGE LTS SUP	15-216	L237	D12

Throttle Switch Pack/Engine No.1

ENG 1 REHEAT CONT	15-216	1K1542	E 9
ENG 1 WIND DOWN CONT SUP 1	5-213	1K1101	B 1
ENG 1 WIND DOWN CONT SUP 2	1-213	1K1108	C 7
ENG 1 REV THRUST CONT	3-213	1K331	D 1
ENG 1 PP MGT LTS SUP	5-213	1E461	D 1

Throttle Switch Pack/Engine No.2

ENG 2 REHEAT CONT	15-215	2K1542	D15
ENG 2 WIND DOWN CONT SUP 1	1-213	2K1101	F 4
ENG 2 WIND DOWN CONT SUP 2	5-213	2K1108	C 1
ENG 2 REV THRUST CONT	1-213	2K331	B 5
ENG 2 PP MGT LTS SUP	1-213	2E461	E 3

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Throttle Switch Pack/Engine No.3			
ENG 3 REHEAT CONT	15-215	3K1542	D16
ENG 3 WIND DOWN CONT SUP 1	1-213	3K1101	F 5
ENG 3 WIND DOWN CONT SUP 2	5-213	3K1108	C 2
ENG 3 REV THRUST CONT	1-213	3K331	B 6
ENG 3 PP MGT LTS SUP	1-213	3E461	E 4
Throttle Switch Pack/Engine No.4			
ENG 4 REHEAT CONT	15-216	4K1542	E10
ENG 4 WIND DOWN CONT SUP 1	5-213	4K1101	B 2
ENG 4 WIND DOWN CONT SUP 2	1-213	4K1108	C 8
ENG 4 REV THRUST CONT	3-213	4K331	D 2
ENG 4 PP MGT LTS SUP	5-213	4E461	D 2

(2) If nose is up, fit one safety locking pin to each of the two nose uplocks.

(3) Remove the centre console side panels:

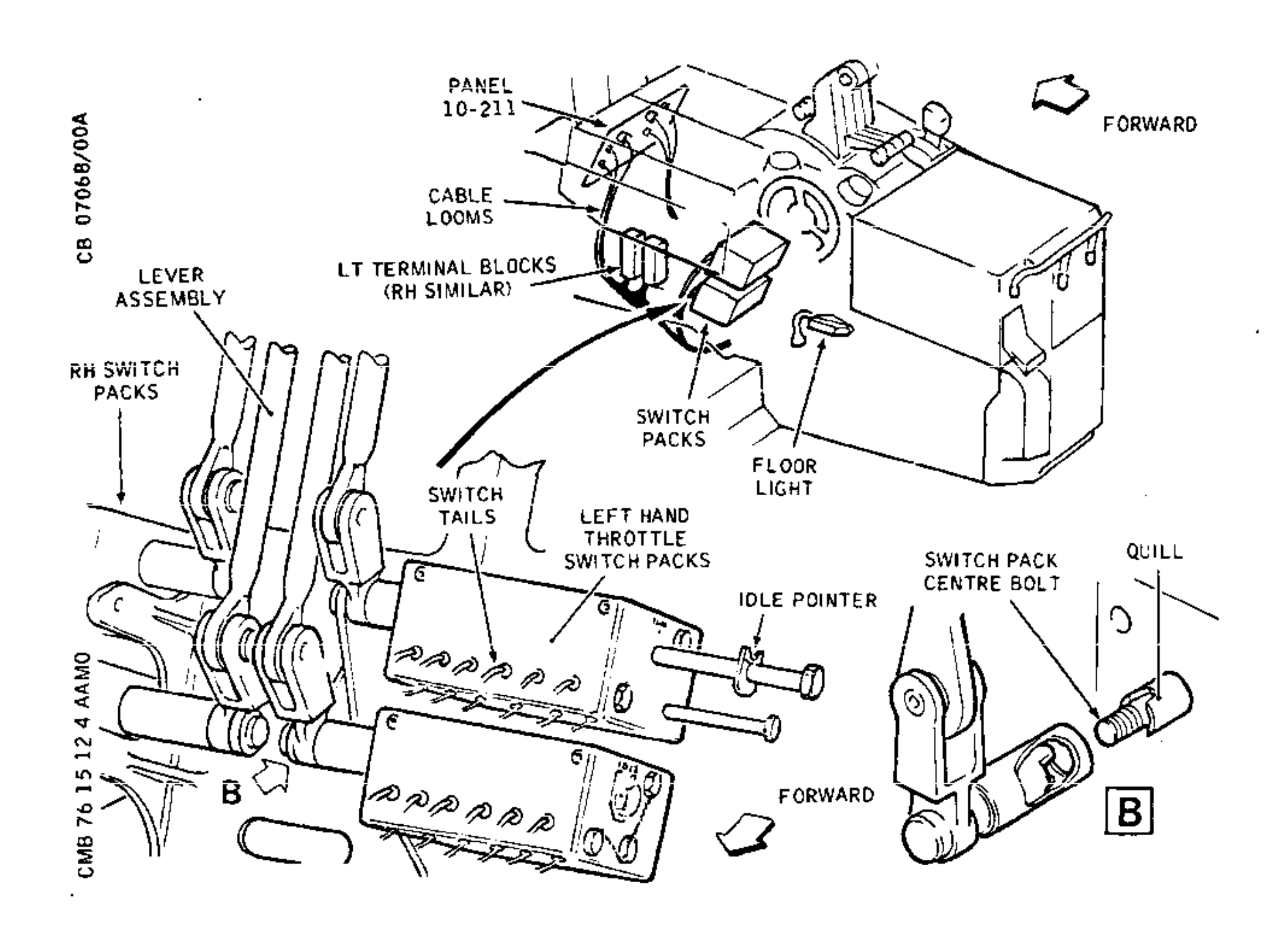
(a) Release the screws securing the forward and aft side panels and remove the forward panels.

(b) Ease the aft panels away from the console structure and disconnect the electrical plugs for the pilots' floor illumination at the receptacles, U2025 on the left-hand panel and U2026 on the right-hand panel.

(c) Remove the left-hand panel.

(d) Disengage the droop nose emergency drop control handle from its stowage on the right-hand aft panel by pulling the ring on the pip-pin, taking great care not to rotate the handle.

(e) Ease the aft panel away from the console structure, insert hand between panel and structure and depress the release stud on the shaft end of the control handle. Carefully withdraw the handle from its shaft.



Forward Thrust Throttle Switch Packs
Figure 401

R

(f) Remove the aft panel.

(4) Place the four throttle levers in the IDLE position.

C. Remove Forward Thrust Throttle Switch Packs (Ref. Fig. 401)

(1) Release switch pack cable loom clipping.

(2) Disconnect as necessary, the switch pack cable plugs on panel 10-211.

(3)) Disconnect the switch pack wire tails from terminal blocks UM2068, UM2070, UM2071 and UM2072 as required, using appropriate insertion/extraction tool.

(4) Remove the centre bolt and the three fixing bolts from the switch pack and withdraw pack complete with quill and wire tails from the console.

D. Install Forward Thrust Throttle Switch Packs. (Ref. Fig. 401)

(1) Comply with the electrical safety precautions.

(2) Ensure that the two safety pins (if fitted) are still engaged in the droop nose uplocks.

(3) Ensure that the switch pack areas within the console are clean.

(4) Place the throttle levers in the IDLE position.

(5) For any one of the four forward thrust switch packs:

(a) Assemble the centre bolt, IDLE pointer and quill to the switch pack, rotate the centre bolt assembly until pointer indicates IDLE.

(b) Position the switch pack on the console casting and loosely engage the centre bolt with the relevant throttle lever assembly.

(c) Insert and torque-tighten the three fixing bolts to 50 - 60 lbf in (0.57 - 0.68 mdaN).

(d) Torque-tighten the centre bolt to 90 - 105 lbf in (1.02 - 1.19 mdaN).

(6) Using steel wire 0.031 in (0.8 mm) dia (Ref. 20-21-13).

(a) Wirelock the centre bolt head to the IDLE pointer.

(b) Wire-lock the fixing bolts in a group of three.

(7) Using the crimping and insertion/extraction tools in accordance with the Wiring Diagram Manual (Ref. 20-43-09 and 20-42-18 respectively) fit the leads/ contacts to the appropriate pin positions of the plug or terminal block according to the cable identification and the applicable wiring diagram. Re-assemble plugs and, ensuring that mating surfaces are clean and undamaged, reconnect to the respective receptacles on panel 10-211.

(8) Wrap the loom at the clip positions using Vidaflex, then, ensuring that the wrapping extends approximately 0.125 in (3.175 mm) each side of the clip, secure the clips in position.

(9) Using PTFE tape, wrap the loom at lead junctions and where the loom may contact metal surfaces.

(10) Test the switch pack. (Ref. 76-15-12, Adjustment/Test).

R B (11) When removing/installing the "Forward Thrust Throttle
R B Switch Packs" make an entry in the Aircraft Technical
R B Report (Sector Defect Log) that a secondary nozzle
R B ASOV check must be carried out on departure from that
R B station/base.

E. Conclusion

(1) Install the centre console forward and aft side panels:

(a) Ensure that the console area is clean.

(b) Attach the left-hand and right-hand forward panels and torque-tighten the fixing screws to 40 - 45 lbf in (0.45 - 0.51 mdaN).

(c) Loosely position the left-hand aft panel and connect the floor illumination electrical plug to receptacle ref. U2025 on the panel.

(d) Torque-tighten the panel fixing screws to 40 - 45 lbf in (0.45 - 0.51 mdaN).

(e) Loosely position the right-hand aft console panel and connect the floor illumination plug to receptacle ref. U2026 on the panel.

(f) Attach the droop nose emergency drop control handle by depressing the release stud on the handle and sliding the handle onto its shaft until the release stud mechanism engages with its housing in the shaft.

(g) Torque-tighten the panel fixing screws to 40 - 45 lbf in (0.45 - 0.51 mdaN).

(h) Stow the control handle by pressing the pip-pin into its housing on the panel.

(2) Remove the two safety pins from the droop nose uplocks.

(3) Remove the safety clips and reset the circuit breakers which were not reset after the Adjustment and Test operation.

(4) Carry out a functional test of the pilots' floor illumination circuit (Ref. 33-00-00).

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FORWARD THRUST THROTTLE SWITCH PACKS - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS IN 24-00-00.

1. General

The forward thrust switch packs are located forward of the centre console casting at floor level and are accessible with the centre console side panels removed. Each pack contains 12 switches. Switches 1 to 6 are individually adjustable in-situ, switches 7 to 12 are not. Switches 7 to 12 may, however,
R be adjusted on the rod and turnbuckle assembly (Ref.76-11-25). This adjustment will alter all the switches in the associated switch pack simultaneously and must be followed by a further check on all the switch settings.

The instructions apply to No.1 throttle switch pack and should be repeated, as necessary on the other forward throttle switch packs.

2. Adjustment

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Optical measuring tool	OV6A01
Gauge position	OG6A01
Lamp and battery	-
Screwdriver (Torq set)	-
Torque spanner range: 10 lbf in (0.11 mdaN) R 50 to 45 lbf in (0.45 to 0.51 mdaN)	-
Corrosion resistant locking R wire 0.031 in (0.8 mm) dia	- DTD189
Allen Key	-

B. Prepare. (Ref. Fig.501 and 502)

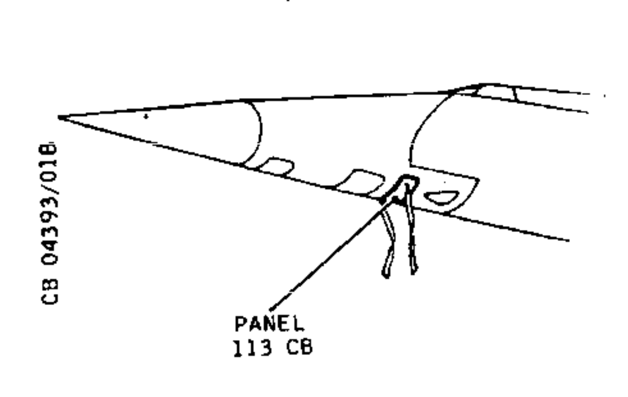
(1) Trip the appropriate circuit breakers and fit safety clips.

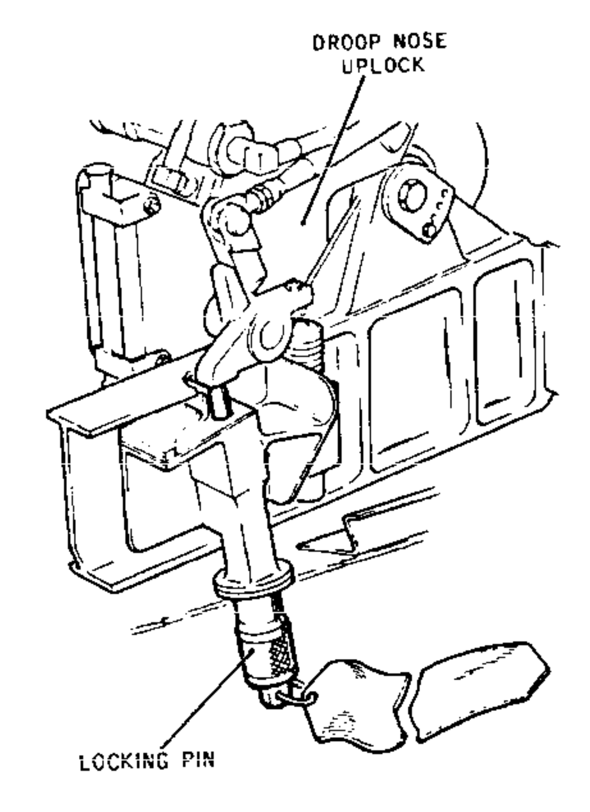
SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
AT SYS 1 SUP	3-213	1C179	C6
AT 1 CONT	1-213	1C180	Q12
AT SYS 2 SUP	13-213	2C179	D16
AT 2 CONT	5-213	2C180	A14
SYS 1 GRD PRESSN CONT.	15-215	H1157	E3
SYS 1 DITCHING VALVE CONT.	1-213	H1149	G13
SYS 1 FWD & AFT DISCHARGE VALVE SUP	5-213	H1125	E8
SYS 2 GRD PRESSN CONT.	15-216	H1158	D23
SYS 2 DITCHING VALVE CONT.	1-213	H1150	F10
SYS 2 FWD & AFT DISCHARGE VALVE SUP	1-213	H1124	E13
CABIN OVER PRESS IND	5-213	H1126	E9
NOSE 7 1/2° CONT	1-213	M12	Q16
VISOR AND NOSE CONT	15-215	M11	F8
NOSE/VISOR ST'BY LOWER SUP	1-213	M13	Q17
CHART STOWAGE LTS SUP	15-216	L237	D12
AUDIO WARN SYS SUP 1	1-213	W371	M21
AUDIO WARN SYS SUP 2	5-213	W372	C17
AUDIO WARN O/SPEED SUP 1	1-213	W374	S19
AUDIO WARN O/SPEED SUP 2	5-213	W373	C18
WHEELS 2 3A/SKID 5 8 ADAPT AMPS SUP	14-215	G185	B5
WHEELS 6 7A/SKID 1 4 ADAPT AMPS SUP	14-216	G186	A12
WHEELS 5 8A/SKID 2 3 ADAPT AMPS SUP	13-216	G187	C12
WHEELS 1 4A/SKID 6 7 ADAPT AMPS SUP			
RATING IND SUP	3-213	K2300	G5

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF
Engine No.1			
ENG 1 MAIN THROT CONT.	3-213	1K3	A1
ENG 1 ALT THROT CONT.	15-216	1K4	E8
ENG 1 REHEAT CONT.	15-216	1K1542	E9
ENG 1 WIND DOWN CONT.SUP 1	5-213	1K1101	B1
ENG 1 WIND DOWN CONT.SUP 2	1-213	1K1108	C7
ENG 1 REV THRUST CONT.	3-213	1K331	D1
ENG 1 P.P. MGT LTS SUP	5-213	1E461	D1
ENG 1 RATING CONT	3-213	1K8	C3
Engine No.2			
ENG 2 MAIN THROT CONT	1-213	2K3	A3
ENG 2 ALT THROT CONT	15-215	2K4	F15
ENG 2 REHEAT CONT	15-215	2K1542	D15
ENG 2 WIND DOWN CONT SUP 1	1-213	2K1101	F4
ENG 2 WIND DOWN CONT SUP 2	5-213	2K1108	C1
ENG 2 REV THRUST CONT	1-213	2K331	B5
ENG 2 PP MGT LTS SUP	1-213	2E461	E3
ENG 2 RATING CONT	1-213	2K8	E8
Engine No.3			
ENG 3 MAIN THROT CONT	1-213	3K3	A4
ENG 3 ALT THROT CONT	15-215	3K3	F16
ENG 3 REHEAT CONT	15-215	3K1542	D16
ENG 3 WIND DOWN CONT SUP 1	1-213	3K1101	F5
ENG 3 WIND DOWN CONT SUP 2	5-213	3K1108	C2
ENG 3 REV THRUST CONT	1-213	3K331	B6
ENG 3 PP MGT LTS SUP	1-213	3E461	E4
ENG 3 RATING CONT	1-213	3K8	E2
Engine No.4			
ENG 4 MAIN THROT CONT	3-213	4K3	A2
ENG 4 ALT THROT CONT	15-216	4K4	F11
ENG 4 REHEAT CONT	15-216	4K1542	E10
ENG 4 WIND DOWN CONT SUP 1	5-213	4K1101	B2
ENG 4 WIND DOWN CONT SUP 2	1-213	4K1108	C8
ENG 4 REV THRUST CONT	3-213	4K331	D2
ENG 4 PP MGT LTS SUP	5-213	4E461	D2
ENG 4 RATING CONT	3-213	4K8	C4

(2) Remove the centre console aft left-hand side panel:

(a) Release the screws securing the panel.





CMB 76 15 12 5 AAM0

Droop Nose Locking Pins
Figure 501

(b) Disconnect the electrical plug for the pilots' floor illumination at the receptacle identified U2026 on the panel.

(c) Lift the panel clear of the spigots and remove the panel.

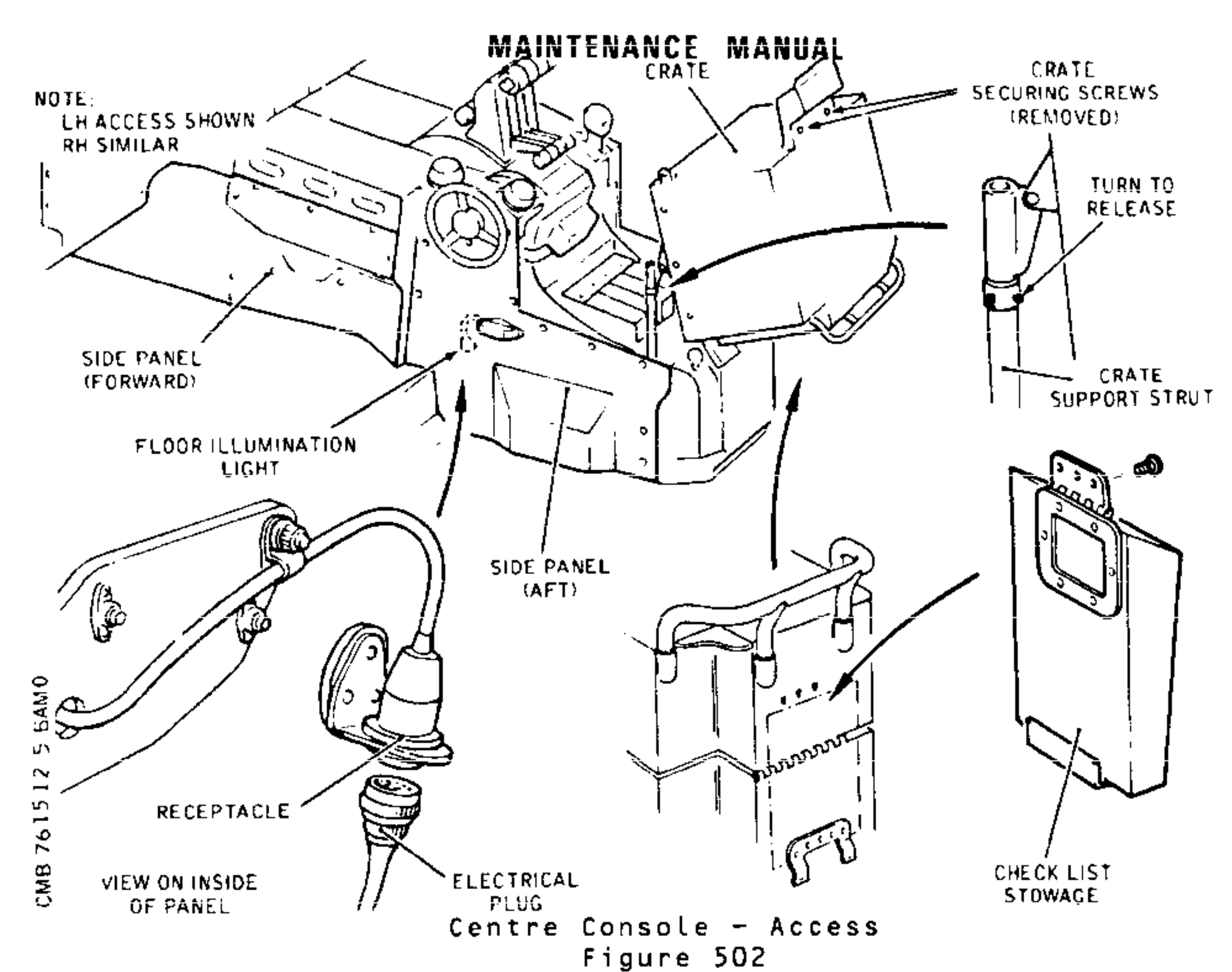
(3) Remove the droop nose emergency lever (Ref. Fig. 501)

NOTE: This can be done with the nose either up or down.

(a) If the nose is up, fit safety pins (2) in the droopnose mechanism.

(b) Remove the quick-release pin at the aft end of the droop nose emergency lever.

(c) Reach through the centre console from the left-hand side and depress the spring loaded pin on the forward end of the droop nose



Centre Console - Access
Figure 502

emergency lever; remove the lever.

(4) Remove the centre console aft right-hand side panel in a similar manner to that described for the left-hand; the electrical identification is U2025.

(5) Remove the centre console forward side panels.

(6) Remove the screws securing the check list stowage, remove the stowage.

(7) Remove the securing screws and hinge back the crate.

(8) To improve access to the centre console remove, if necessary, the co-pilots' seat (Ref.25-11-21, Removal/ Installation).

(9) Remove Nos 1 and 2 throttle transmitters.

NOTE: To fit an optical measuring tool in No 1 throttle channel it is necessary to remove also

the adjacent transmitter.

(a) Set the throttle levers to 'idle'.

(b) Unscrew the knurled nut and withdraw the transmitter.

(10) Insert the optical measuring tool for measuring rotation of the transmitter drive coupling (Ref. 76-11-00, Adjustment/Test) into No 1 position.

C. Adjust (Ref. Fig. 503)

NOTE: 1. Wire-lock switch and cover screws (Ref, 20-21-13).

2. Make electrical plug connections (Ref.WDM 20-42-34).

3. Cap and stow spare switch leads (Ref. WDM 20-41-01).

(1) It is assumed that the switch packs are installed (Ref.76-15-12, Removal/Installation) but the switch leads are not connected. If the switch leads are connected it may be necessary to disconnect them from the plugs on panel 10-211 for this test.

(2) Set the No 1 throttle lever to idle; check that the "IDLE" pointer on No 1 switch pack is aligned with the marking on the pack, and the reading on the
R optical tool is between 35 deg 50 min and 36 deg 10 min.

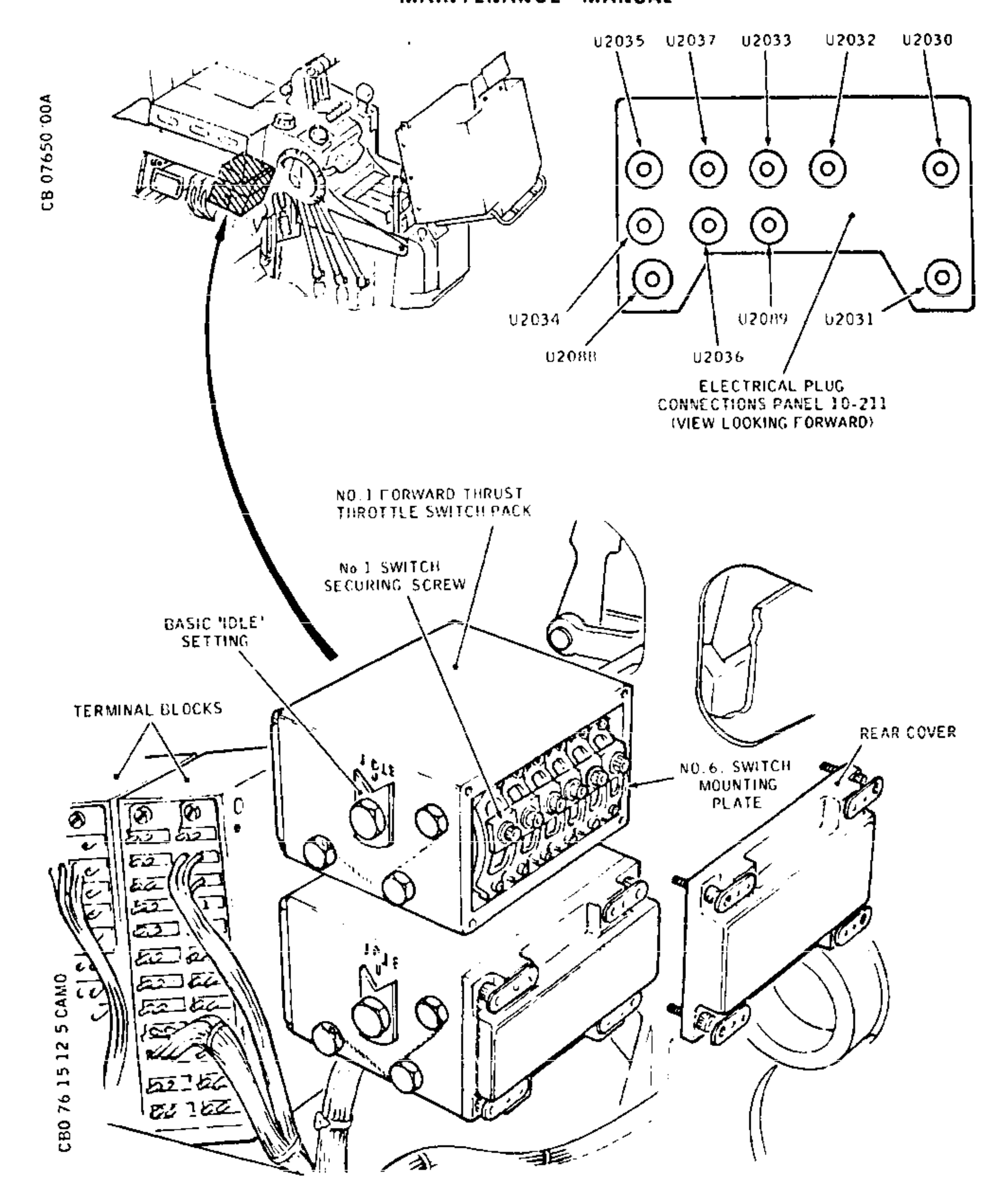
NOTE: If these readings are not obtained check the calibration of the optical measuring tool (Ref.76-11-00, Adjustment/Test).

(3) Check the non-adjustable switches:

(a) Using a lamp and battery on the leads from each switch in turn, move the forward thrust lever from idle to maximum rpm and check and record the make and break points of switches 10 and 11, 7 and 8, 9 and 12 (Ref. Table 501 to 504).

(b) Move the forward thrust lever from maximum rpm to idle and check and record the make and break points of switches 10 and 11, 7 and 8, 9 and 12 (Ref. Table 501 to 504).

NOTE: The switches should operate as near as



Forward Thrust Throttle Switch Packs - Testing
Figure 503

possible in the middle of the tolerance zone and switch pairs should make and break as near as possible together.

(4) Adjust, if necessary, on the turnbuckle and lever assembly of No.1 throttle lever (Ref.76-11-25, Removal/Installation), this adjustment will affect switches: 10 and 11, 7 and 8, 9 and 12 equally, and also switches 1 to 6.

NOTE: The setting of the turnbuckle and lever assembly should not alter in service unless a throttle lever, or lever assembly has been changed. It may be quicker to remove the switch pack and fit a replacement (bench tested) switch pack.

The switch settings in degrees are as observed on the scale of the optical measuring tool.

(5) Check the adjustable switches.

(a) Move the forward thrust lever from idle to maximum rpm and back and check the make and break point of switch No.1 using the switch leads and the cable identification (Ref. Table 501 to 504).

(6) To adjust the switch remove the rear cover from No.1 switch pack and adjust:

(a) Use an Allen key to loosen the four cover screws, remove the cover.

(b) Loosen the switch securing screw and move the switch assembly along the slot in its mounting plate until the switch makes and breaks within the limits specified in the table (Ref. Table 501 to 504).

R (c) Torque-tighten the switch securing screw to
R 10 lbf in (0.11 mdaN) and wire-lock.

NOTE: If the required setting cannot be obtained a fine adjustment is available but this is impracticable unless the switch pack is removed and stripped down on the bench.

(7) Repeat the check and adjustment on each of the other adjustable switches; Nos. 2, 3, 4, 5 and 6 (Ref.para

3).

NOTE: Switch Nos 1 and 2, and 3 and 4 are paired switches and, in addition to operating within prescribed limits, should also operate as nearly as possible together.

(8) Replace the cover and secure it with the cover screws.
R Torque-tighten each screw to 10 lbf in (0.11 mdaN)
R and wire-lock.

(9) Connect the switch leads to the plugs U2030, U2031, U2032, U2034, U2035, U2036 and U2037 on panel 10-211 ensuring that the connections are made in accordance with the switch lead identifications and the applicable wiring diagram. Connect the plugs to the
R sockets and secure each socket in accordance with WDM 20-42-34.

D. Conclusion

R NOTE: Torque-tighten screws (Ref.20-21-11).

(1) Remove the optical measuring tool.

(2) Replace throttle transmitters (Ref.76-11-12, Removal/Installation.

(3) Check that the area is clean, release the locking struts, and hinge forward the crate. Insert the
R two securing screws and torque-tighten them to between
R 70 and 80 lbf in (0.79 to 0.90 mdaN).

(4) Engage the check list stowage with the rear of the crate; fit and tighten the securing screws.

(5) Replace the centre console aft right-hand side panel:

(a) Check the panel seals for damage and security.

(b) Loosely engage the panel.

(c) Connect the pilots' floor illumination at the receptacle identified U2025 on the panel.

R (d) Torque-tighten the panel screws to between 40
R and 45 lbf in (0.45 and 0.51 mdaN).

(6) Fit the droop nose emergency release lever on the right-hand side of the centre console and insert the quick-release pin.

(7) Secure the centre console aft left-hand side panel in a manner similar to that desribed for the right-hand panel, the electrical plug is identified U2026.

(8) Secure the centre console forward panels and torque-tighten the panel screws to between 40 and 45 lbf in
R (0.45 to 0.51 mdaN).

(9) If necessary, replace the co-pilots' seat (Ref. 25-11-21, Removal/Installation).

(10) Remove droop nose locking pins (2).

(11) Remove the safety clips and reset the circuit breakers previously tripped.

R (12) Carry out the following functional tests:

(a) Mechanical input test (Ref. 76-11-00, Adjustment/ Test).

R (b) Reheat ignition (Ref.76-15-00, Adjustment/Test).

(c) Bucket Control System Wind-Down (Ref.78-00-00, Adjustment/Test).

(d) Air conditioning system (Ref.21-35-00, Adjustment/Test).

(e) Auto throttle system (Ref.22-31-00, Adjustment/ Test).

R (f) Landing gear warning system (Ref.32-61-00, Adjustment/Test).

(g) Throttle control system (Ref.76-11-00, Adjustment/Test).

3. Test

A. Equipment and Materials.

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Optical measuring tool	QV6A01

DESCRIPTION	PART NO.
Gauge position	QG6A01
Lamp and battery	-
Screwdriver (Torq set)	-
R Corrosion resistant locking R wire 0.031 in (0.8 mm) dia	DTD189
Allen key	

B. Prepare (Ref. Fig.501 and 502)

R (1) Carry out the preparation procedure in para 2.

C. Test (Ref. Fig. 503)

NOTE: 1. Make electrical plug connections (Ref.WDM 20-42-34)
2. Cap and stow spare switch leads (Ref.WDM 20-41-01)

(1) Set throttle levers 2, 3 and 4 to idle.

(2) Carry out the following checks on the switches in
R No. 1 forward switch pack, using the switch leads and
R No. 1 throttle lever, and reading off the switch make and break points from the scale of the optical measuring tool in No. 1 transmitter racking channel.

NOTE: 1. The switches should operate as near as possible to the middle of the tolerance zone and switch pairs should operate as nearly as possible together.

2. Check the setting of the optical measuring tool, if necessary in accordance with 76-11-00, Adjustment/Test.

	NO.	SWITCH PACK IDENT	MONITOR CONNECTIONS	SWITCH SETTING	THROTTLE LEVER	TEST LAMP	SYSTEM
	1	1K1548-1	U2035)		IDLE	OFF	
			A to B)	1°01"	MAX	ON	AUTO THROTTLE
			U-2035)	±0°36"	MAX	OFF	
			A to U)		IDLE	ON	
	2	1K1548-2	U-2035)		IDLE	OFF	
			G to H)	1°01"	MAX	ON	AUTO THROTTLE
			U-2035)	±0°36"	MAX	OFF	
			G to W)		IDLE	ON	
	3	1K1548-3	U-2035)		IDLE	ON	
			C to D)	29°54"	MAX	OFF	AUTO THROTTLE
			U-2035)	±0°25"	MAX	ON	
			C to T)		IDLE	OFF	
R	**ON A/C ALL						
R	B 4	IK1548-4	U-2035)		IDLE	ON	
R	B		J to K)	29°54"	MAX	OFF	AUTO THROTTLE
R	B		U-2035)	±0°25"	MAX	ON	
R	B		J to V)		IDLE	OFF	
R	**ON A/C ALL						
	5	1K1548-5					THROTTLE
			U-2035)	1°01"	MAX	ON	CONTROL (95%)
			P to S)	±0°36"	IDLE	OFF	
	6	1K1548-6					NOT USED
	7	1K1548-7	U-2035)		IDLE	ON	
			b to c)	4°04"	MAX	OFF	LANDING GEAR
			U-2035)	±1°30"	MAX	ON	WARNING
			b to a)		IDLE	OFF	HORN
	8	1K1548-8	U-2035)		IDLE	ON	
			e to f)	4°04"	MAX	OFF	LANDING GEAR
			U-2035)	±1°30"	MAX	ON	WARNING
			e to d)		IDLE	OFF	HORN
	9	1K1548-9					PRESSURISATION
			U-2035)	2°26"	MAX	ON	SYSTEM 1

NO.	SWITCH PACK IDENT	MONITOR CONNECTIONS	SWITCH SETTING	THROTTLE LEVER	TEST LAMP	SYSTEM
		g to h)	±1°30"	IDLE	OFF	CONTROL
10	1K1548-10	U-2035)		IDLE	OFF	
		Z to Y)	34°00"	MAX	OFF	REHEAT
		U-2035)	±1°30"	MAX	ON	CONTROL
		Z to X)		IDLE	OFF	
11	1K1548-11	U-2035)		IDLE	OFF	ENGINE
		N to M)	34°00"	MAX	ON	POWER
			±1°30"			WIND DOWN
12	1K1548-12					PRESSURISATION
		U-2030)	2°26"	MAX	ON	SYSTEM 2
		g to h)	±1°30"	IDLE	OFF	CONTROL

Engine No.1 Forward Switch Pack
Table 501

	NO.	SWITCH PACK IDENT	MONITOR CONNECTIONS	SWITCH SETTING	THROTTLE LEVER	TEST LAMP	SYSTEM
	1	2K1548-1	U-2037)		IDLE	OFF	
			A to B)	1°01"	MAX	ON	AUTO THROTTLE
			U-2037)	±0°36"	MAX	OFF	
			A to U		IDLE	ON	
	2	2K1548-2	U-2037)		IDLE	OFF	
			G to H)	1°01"	MAX	ON	AUTO THROTTLE
			U-2037)	±0°36"	MAX	OFF	
			G to W)		IDLE	ON	
	3	2K1548-3	U-2037)		IDLE	ON	
			C to D)	29°54"	MAX	OFF	AUTO THROTTLE
			U-2037)	±0°25"	MAX	ON	
			C to T)		IDLE	OFF	
R	4	2K1548-4	U-2037)		IDLE	ON	
R			J to K)	29°54"	MAX	OFF	AUTO THROTTLE
R			U-2037)	±0°25"	MAX	ON	
R			J to V)		IDLE	OFF	
	5	2K1548-5					
							THROTTLE
			U-2037)	1°01"	MAX	ON	CONTROL (95%)
			P to S	±0°36"	IDLE	OFF	
R	6	2K1548-6	U-2037)		IDLE	ON	
R			E to F)	27°00"	MAX	OFF	WHEEL BRAKES
				±0°36"			(THROTTLES 2
							& 3 ONLY)
	7	2K1548-7	U-2037)		IDLE	ON	LANDING GEAR
			b to c)	4°04"	MAX	OFF	WARNING
			U-2037)	±1°30"	MAX	ON	HORN
			b to a)		IDLE	OFF	
	8	2K1548-8	U-2037)		IDLE	ON	
			e to f)	4°04"	MAX	OFF	LANDING GEAR
			U-2037)	±1°30"	MAX	ON	WARNING
			e to d)		IDLE	OFF	
	9	2K1548=9					PRESSURISATION
			U-2035)	2°26"	MAX	ON	SYSTEM 1
			g to h)	±1°30"	IDLE	OFF	CONTROL
	10	2K1548-10	U-2037)		IDLE	OFF	
			Z to Y)	34°00"	MAX	OFF	REHEAT

NO.	SWITCH PACK IDENT	MONITOR CONNECTIONS	SWITCH SETTING	THROTTLE LEVER	TEST LAMP	SYSTEM
		U-2037) Z to X)	±1°30"	MAX IDLE	ON OFF	CONTROL
11	2K1548-11	U--2037) N to M)	 34°00" ±1°30"	IDLE MAX	OFF ON	 ENGINE POWER WIND DOWN
12	2K1548-12					
		U-2030) g to h)	2°26" ±1°30"	MAX IDLE	ON OFF	PRESSURISATION SYSTEM 2 CONTROL

Engine No.2 Forward Switch Pack
Table 502

NO.	SWITCH PACK IDENT	MONITOR CONNECTIONS	SWITCH SETTING	THROTTLE LEVER	TEST LAMP	SYSTEM
1	3K1548-1	U-2032) A to B) U-2032) A to U)	1°01" ±0°36"	IDLE MAX MAX IDLE	OFF ON OFF ON	AUTO THROTTLE
2	3K1548-2	U-2032) G to H) U-2032) G to W)	1°01" ±0°36"	IDLE MAX MAX IDLE	OFF ON OFF ON	AUTO THROTTLE
3	3K1548-3	U-2032) C to D) U-2032) C to T)	29°54" ±0°25"	IDLE MAX MAX IDLE	ON OFF ON OFF	AUTO THROTTLE
R R R R 4	3K1548-4	U-2032) J to K) U-2032) J to V)	29°54" ±0°25"	IDLE MAX MAX IDLE	ON OFF ON OFF	AUTO THROTTLE
5	3K1548-5	U-2032) P to S)	1°01" ±0°36"	MAX IDLE	ON OFF	THROTTLE CONTROL (95%)
R R 6	3K1548-6	U-2032) E to F)	27°00" ±0°36"	IDLE MAX	ON OFF	WHEEL BRAKES (THROTTLES 2 & 3)
7	3K1548-7	U-2032) b to c) U-2032) b to a)	4°04" ±1°30"	IDLE MAX MAX IDLE	ON OFF ON OFF	LANDING GEAR WARNING HORN
8	3K1548-8	U-2032) e to f) U-2032) e to d)	4°04" ±1°30"	IDLE MAX MAX IDLE	ON OFF ON OFF	LANDING GEAR WARNING HORN
9	3K1548-9	U-2035) g to h)	2°26" ±1°30"	MAX- IDLE	ON OFF	PRESSURISATION SYSTEM 1 CONTROL

NO.	SWITCH PACK IDENT	MONITOR CONNECTIONS	SWITCH SETTING	THROTTLE LEVER	TEST LAMP	SYSTEM
10	3K1548-10	U-2032)		IDLE	OFF	
		Z to Y)	34°00"	MAX	OFF	REHEAT
		U-2032)	±1°30"	MAX	ON	CONTROL
		Z to X)		IDLE	OFF	
11	3K1548-11	U-2032)	34°00"	IDLE	OFF	ENGINE
		N to M)	±1°30"	MAX	ON	POWER
						WIND DOWN
12	3K1548-12					
						PRESSURISATION
		U-2030)	2°26"	MAX	ON	SYSTEM 2
		g to h)	±1°30"	IDLE	OFF	CONTROL

Engine No.3 Forward Switch Pack
Table 503

	NO.	SWITCH PACK IDENT	MONITOR CONNECTIONS	SWITCH SETTING	THROTTLE LEVER	TEST LAMP	SYSTEM
	1	4K1548-1	U-2030)		IDLE	OFF	
			A to B)	1°01"	MAX	ON	AUTO THROTTLE
			U-2030)	±1°36"	MAX	OFF	
			A to U)		IDLE	ON	
	2	4K1548-2	U-2030)		IDLE	OFF	
			G to H)	1°01"	MAX	ON	AUTO THROTTLE
			U-2030)	±0°36"	MAX	OFF	
			G to E)		IDLE	ON	
	3	4K1548-3	U-2030)		IDLE	ON	
			C to D)	29°54"	MAX	OFF	AUTO THROTTLE
			U-2030)	±0°25"	MAX	ON	
			C to T)		IDLE	OFF	
R	4	4K1548-4	U-2030)		IDLE	ON	
R			J to K)	29°54"	MAX	OFF	AUTO THROTTLE
R			U-2030)	±0°25"	MAX	ON	
R			J to F)		IDLE	OFF	
	5	4K1548-5					
							THROTTLE
			U-2030)	1°01"	MAX	ON	CONTROL (95%)
			P to S)	±0°36"	IDLE	OFF	
	6	4K1548-6					NOT USED
	7	4K1548-7	U-2030)		IDLE	ON	
			b to c)	4°04"	MAX	OFF	LANDING GEAR
			U-2030)	±1°30"	MAX	ON	WARNING
			b to a)		IDLE	OFF	HORN
	8	4K1548-8	U-2030)		IDLE	ON	
			c to f)	4°04"	MAX	OFF	LANDING GEAR
			U-2030)	±1°30"	MAX	ON	WARNING
			c to d)		IDLE	OFF	HORN
	9	4K1548-9					
							PRESSURISATION
R			U-2035)	2°26"	MAX	ON	SYSTEM 1
R			g to h)	±1°30"	IDLE	OFF	CONTROL
	10	4K1548-10	U-2030)		IDLE	OFF	
			Z to Y)	34°00"	MAX	OFF	REHEAT
			U-2030)	±1°30"	MAX	ON	CONTROL

NO.	SWITCH PACK IDENT	MONITOR CONNECTIONS	SWITCH SETTING	THROTTLE LEVER	TEST LAMP	SYSTEM
		Z to X)		IDLE	OFF	
11	4K1548-11	U-2030)		IDLE	OFF	
		N to M)	34°00" ±1°30"	MAX	ON	ENGINE POWER WIND DOWN
12	4K1548-12					PRESSURISATION
		U-2030)	2°26"	MAX	ON	SYSTEM 2
		g to h)	±1°30"	IDLE	OFF	CONTROLS

Engine No.4 Forward Switch Pack
Table 504

(3) Carry out if necessary, the checks on the other forward throttle switch packs in a similar manner to that described for No.1.

NOTE: When No.2 forward switch pack is to be checked, Nos. 1, 3 and 4 throttles must be at idle, and so on.

(4) When the switch packs have been tested and are within the prescribed limits, connect, if necessary,the switch leads to the plugs U2030, U2031, U2032, U2034, U0236, U2037 on panel 10-211 ensuring that the connections are made in accordance with the switch lead identifications and the applicable wiring diagram. Connect the plugs to the sockets and secure
R each plug in accordance with WDM 20-42-34.

D. Conclusion.

(1) Comply with the items in para 2 Conclusion.

FORWARD THRUST THROTTLE SWITCH PACKS - APPROVED REPAIRS

1. General

The four forward thrust throttle switch packs are located in the centre console support casting. Switch packs No.1 and No.2 are positioned in the LH side and switch packs No.3 and No.4 in the RH side. The shaft of each switch is engaged with its respective throttle lever.

The approved repairs to each switch pack constitute the changing of individual switches in the pack after removal from the console. Each switch pack has provision for twelve switches in two banks of six each. Each bank (No.1 to No.6 and No.7 to No.12) employs a different method of fitting. No.1 to No.6 are adjustable and No.7 to No.12 are fixed.

2. Replacement of Switch Assembly

A. Equipment and Materials

DESCRIPTION	PART NO.
250v Insulation Tester	-
Angular Movement Checking Plate	2431K000
Dial Test Indicator	-
Corrosion resistant steel wire 0.28 in (0.71 mm)	DTD 189
Sleeves, identification	BAS7432 (M002-2)
Surface plate	-
Vee blocks and clamps	-
Test circuit	-
Spring balance	-
R R Torque spanner 0-10 lbf in (0-0.133 mdaN range)	-

B. Preparation

(1) Remove the appropriate switch pack from the centre console (Ref. 76-15-12, Removal/Installation).

C. Removal (Ref. Fig. 801)

(1) Switch Positions No.1 to No.6:

(a) Remove and discard the locking wire from the cover retaining screws; remove the screws and the cover.

(b) Remove and discard the locking wire from the defective switch assembly; remove the top and bottom screws and washers from the slotted plate then remove the slotted plate, complete with the switch assembly, threading the switch leads through the grommet in the switch pack body.

(c) Note the adjusted position of the switch; this is indicated by the register line on the saddle against the graduations on the slotted plate.

(d) Remove and discard the locking wire from the saddle screw; remove the screw, washer, saddle and slotted plate. Remove the switch assembly.

(2) Switch Positions No.7 to No.12:

(a) Remove and discard the locking wire from the switch pack cover retaining screws. Remove the screws and washers. Remove the cover sufficiently to gain access to the defective switch assembly by threading the switch leads carefully through the grommets.

(b) Remove and discard the locking wire from the defective switch assembly, remove the securing screws and washers and remove the switch assembly.

D. Preparation of Replacement Switch Assembly

(1) Check for the correct Part No. and examine the replacement switch assembly for cleanliness and freedom from damage.

(2) For switch positions No.1 to No.6 only - Fit appropriately numbered identification sleeves over all three leads of the switch assembly. Position the sleeve near to the switch body so that the numeral will be visible through the slot in the slotted

plate.

(3) For switch positions No.1 to No.6 only, fit the slotted plate to the switch assembly and secure it with the saddle, washer and screw. Before tightening adjust the switch position to that noted in the removal operation ((1) (d) above).

E. Installation

(1) Switch Positions No.1 to No.6.

(a) Thread the switch leads through the grommet in the switch pack body and at the same time insert the switch assembly into the switch pack
R and secure with washers and screws. Torque-load
R the securing screws to 3 lbf in (0.034 mdaN).
R Torque-load the saddle screw to 10 lbf in (0.113
R mdaN) and wire-lock all three screws.

(b) Fit three appropriately numbered identification sleeves on the switch leads near the lettered sleeves supplied on the switch assembly.

(2) Switch Positions No.7 and No.12:

(a) Insert the switch assembly into the switch pack
R and secure with washers and screws. Torque-load
R the securing screws to 3 lbf in (0.034 mdaN)
R and wire-lock.

(b) Fit three appropriately numbered identification sleeves on the switch leads near the lettered sleeves supplied on the switch assembly.

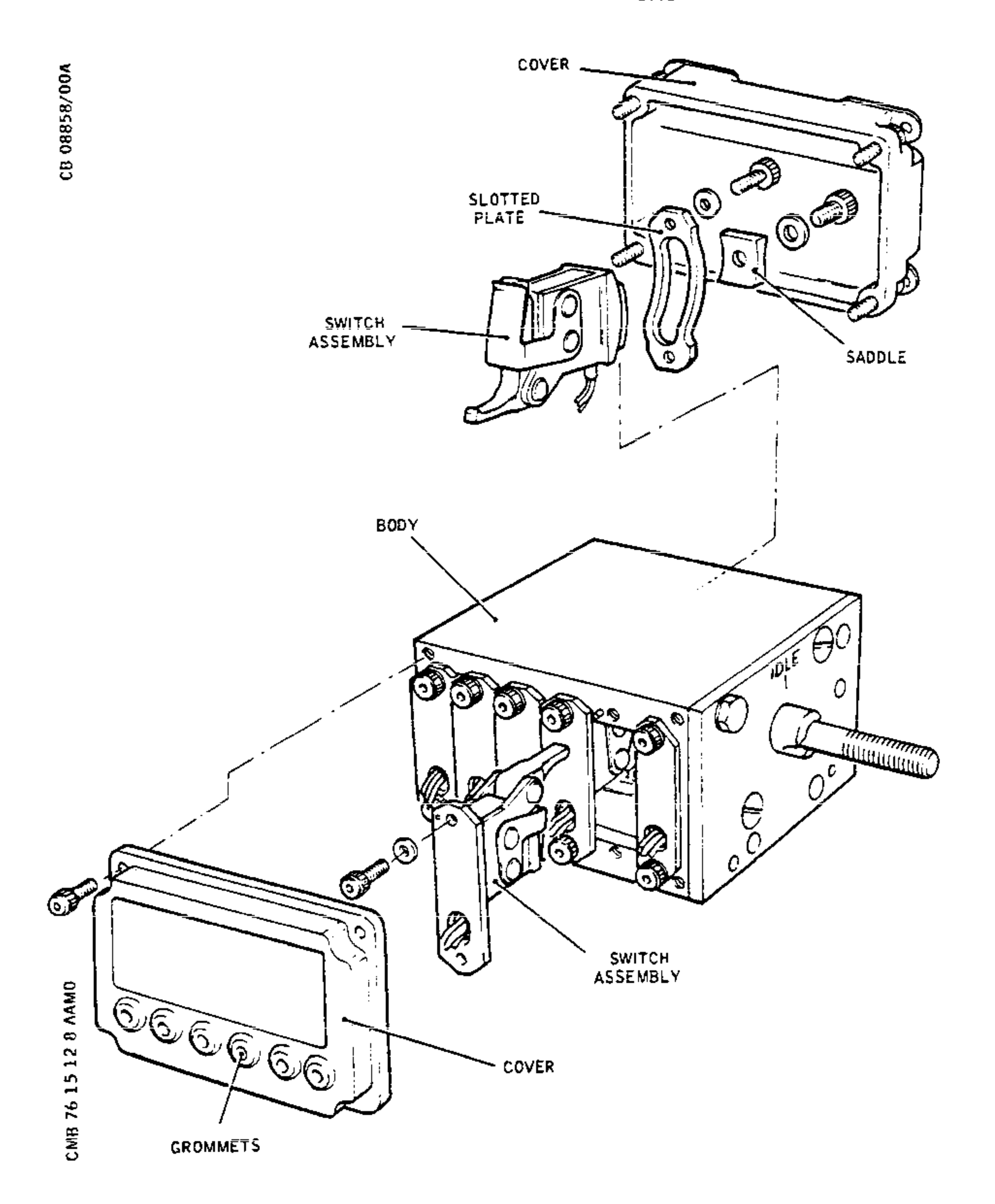
F. Test (Ref. Fig. 802)

(1) Check the Drive Shaft Torque:

(a) Set up the switch pack so that the shaft can be turned with the aid of a lever and a spring balance. Rotate the drive shaft, in both directions, through the full range of movement, and check that the shaft moves smoothly and that the torque at any point does not exceed 3.2 lbf in (0.036 mdaN).

(b) Remove the spring balance and lever.

(2) Check the Operating Movement.



Forward Thrust Throttle Switch Pack -
Switch Assembly Replacement
Figure 801

(a) Set up the switch pack on a surface plate using vee blocks and clamps so that the IDLE datum is vertical.

(b) Fit an angular movement checking plate with pointer to the switch pack and rotate the shaft clockwise until the datum indicates 50 deg 2 min ± 1 deg away from the IDLE position (Ref. Fig. 802) (detail A).

(c) Connect the switch leads to the test circuit and switch ON.

(d) Rotate the drive shaft (Ref. Table 801) and check that the appropriate switch operates before the operating angle. This can be determined by the operation of the test circuit indicating lamps (A-C red lamp illuminated and B-C green lamp illuminated).

NOTE: The switches must change-over sharply. It must not be possible to cause the moving contact to take up a mid position (both lamps in test circuit extinguished) or to creep across the contact gap (indicated by a short period when both lamps are extinguished).

(e) When the shaft position is on change-over for the appropriate switch, set up a dial test indicator to contact the switch lever arm (Ref. Fig. 802) (detail B).

(f) As the rotation is continued beyond switch change-over, check that there is a further 0.005 in (0.127 mm) minimum movement of the switch lever arm.

(g) Reverse the direction of rotation of the shaft and check that the switch changes over before the angle from the datum has been reached (Ref. Table 801).

(h) As the rotation is continued again beyond switch change-over, using the dial test indicator, check that there is a further 0.005 in (0.127 mm) minimum movement of the switch lever arm.

(j) Switch OFF the test circuit, disconnect and remove.

(k) Remove the test equipment from the switch pack.

(l) For switch positions No.1 to No.6, refit the cover and secure with the screws.

(m) For switch positions No.7 to No.12, thread the switch leads through the grommets in the cover, refit the cover and secure with the screws.

(n) Check that the insulation resistance between the following points is not less than 20 Megohms:

(n1) between lead A and lead B.

(n2) between the switch pack housing and leads A, B and C.

SWITCH NO.	POSITION OF DRIVE SHAFT FROM DATUM	TOWARDS DATUM
	36 deg 38 min clockwise	38 deg 08 min clockwise
3	Make C-B	
4	Make C-A	
	47 deg 14 min clockwise	43 deg 14 min clockwise
11	Make C-B	
	47 deg 14 min clockwise	43 deg 14 min clockwise
10	Make C-A	
	25 deg 38 min counter-clockwise	21 deg 38 min counter-clockwise
7	Make C-B	
8	Make C-A	
	30 deg 22 min counter-clockwise	26 deg 22 min counter-clockwise
9	Make C-B	
12	Make C-A	
	33 deg 21 min counter-clockwise	31 deg 51 min counter-clockwise
1	Make C-B	

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SWITCH NO.	POSITION OF DRIVE SHAFT FROM DATUM	TOWARDS DATUM
2	Make C-B	
	33 deg 21 min counter-clockwise	31 deg 51 min counter-clockwise
5	Make C-A	
	30 deg 15 min clockwise	28 deg 45 min clockwise
6	Make C-B	

Switch Operating Angles
Table 801

G. Adjustment

NOTE: An adjusting screw is fitted in the lever arm of each switch assembly to permit fine adjustment of the switch trip point and overrun. The switch assembly must be removed from the switch pack to obtain access to the adjusting screw.

(1) Switch positions No.1 to No.6 only:

(a) Remove the cover by loosening the four captive screws.

(b) Remove and discard the locking wire from the saddle screw.

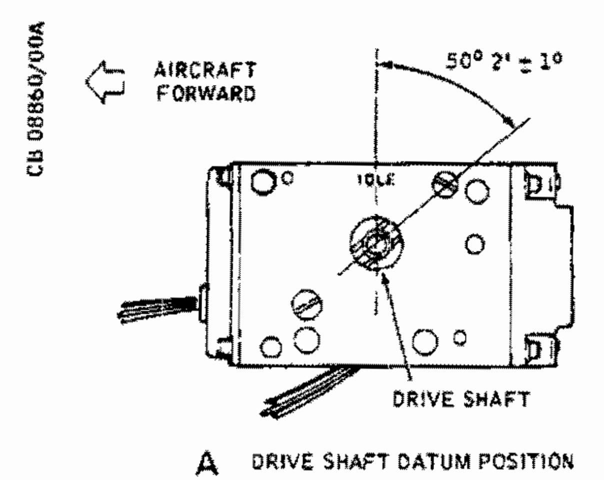
(c) Loosen the saddle screw and move the switch assembly as required along the graduations of the slotted plate. A register line is marked on the saddle and a 6 deg movement each side of the centre position is possible.

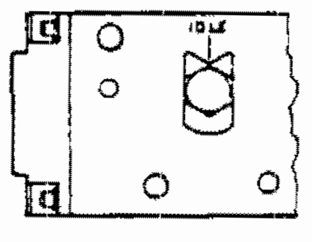
(d) Torque-tighten the saddle screw to 10 lbf in (0.113 mdaN) and wire-lock.

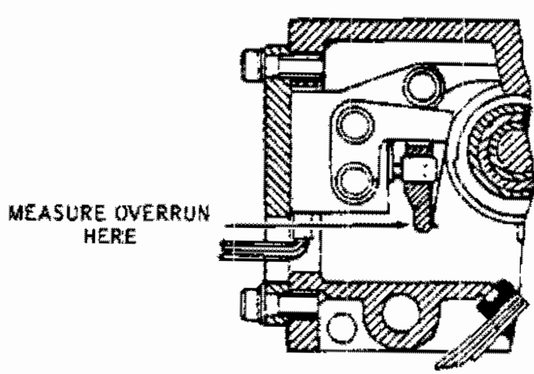
(e) Refit the cover, tighten the four captive screws and wire-lock.

H. Conclusion

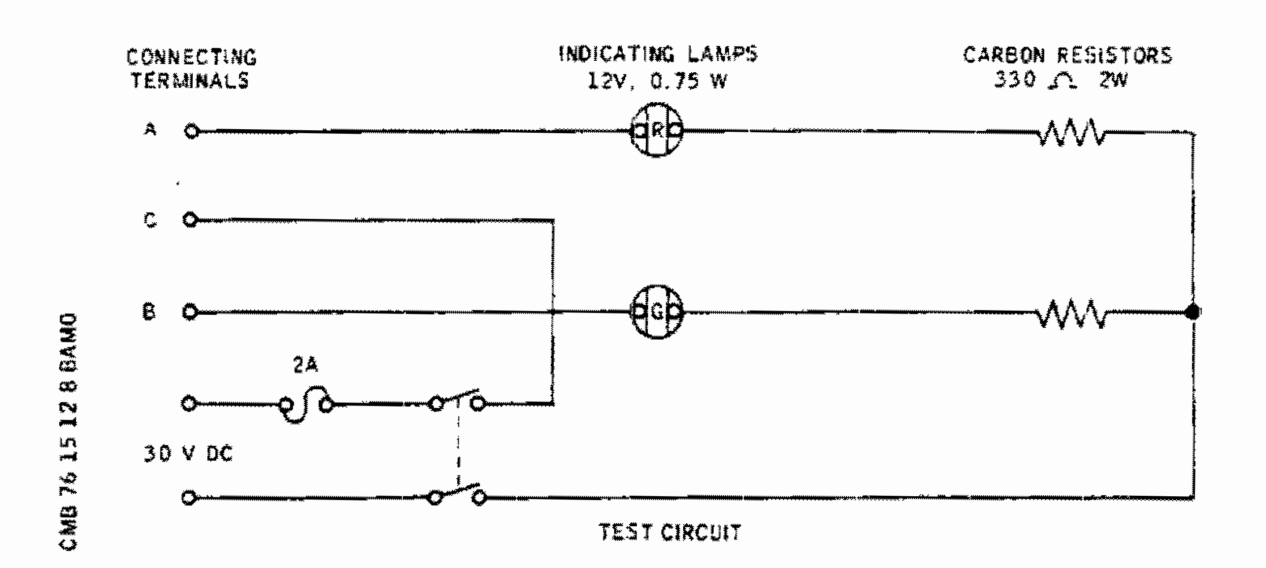
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CMB 76 15 12 8 BAMO



Switch Setting and Test Circuit
Figure 802

(1) Check that both sets of cover screws are secure. Wire-lock the screws.

(2) Refit the switch pack in the console and test (Ref. 76-15-12, Removal/Installation).

PRESSURE SWITCH (REHEAT DETECTION) - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00

1. General

A pressure switch is secured to a bracket in the immediate vicinity of the twin secondary nozzle thrust strut in each engine bay. Access to the switch is gained by opening the engine bay forward and rear doors.

2. Pressure Switch

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner range:	
60-70 lbf in (0.68 and 0.79 mdaN)	-
105 - 115 lbf in (1.18 and 1.30 mdaN)	-

B. Prepare

(1) Open the engine bay lower doors and side panels on the appropriate engine bay (Ref. 71-00-00, Servicing).

C. Remove (Ref. Fig. 401)

(1) Disconnect the flexible and rigid pipes at the unions on the pressure switch.

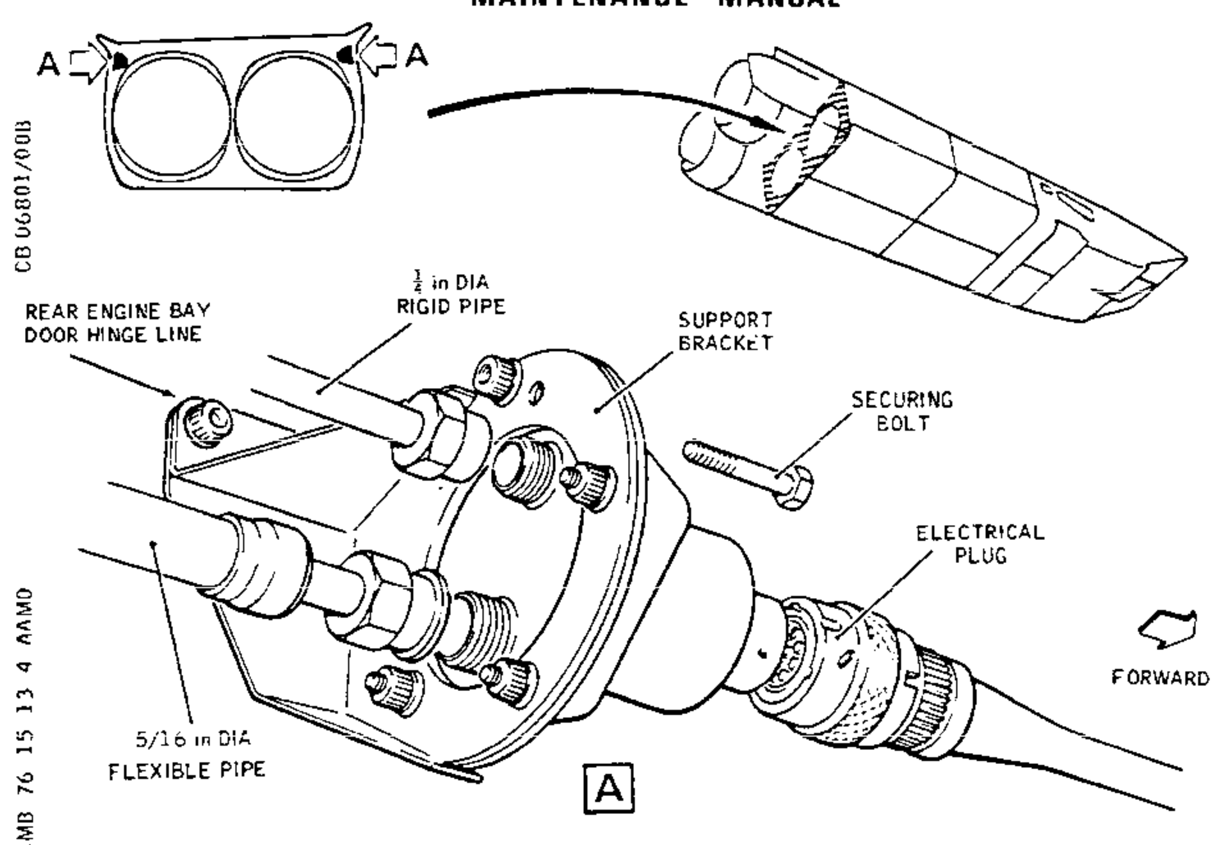
(2) Disconnect the electrical plug from the pressure switch.

(3) Support the pressure switch and remove the bolts securing it to the support bracket; remove the pressure switch.

(4) Fit blanks cover to the pipe ends and to the ports on the pressure switch.

D. Prepare to Install

NOTE: 1. Torque tighten nuts in accordance with



Pressure switch - Installation
Figure 401

20-21-11.

2. Torque tighten pipe union nuts in accordance with 20-23-11.

(1) Comply with the electrical safety precautions.

(2) Remove the blanks cover from the pipe ends and from the ports on the pressure switch.

(3) Check that the connecting pins on the receptacle and on the electrical plug are clean and undamaged.

E. Install (Ref. Fig. 401)

(1) Position the pressure switch on the bracket and secure it with bolts and nuts; torque load each bolt to between 60 and 70 lbf in (0.68 and 0.79 mdaN).

(2) Check that the seatings are clean and undamaged and connect the pipes to the pressure switch in

accordance with 20-23-11 and 20-23-12:

Torque load the smaller dia. rigid pipe union nut to 62 lbf in (0.70 mdaN).

Torque load the larger dia. flexible pipe union nut to 106 lbf in (1.2 mdaN).

(3) Connect the electrical plug to the receptacle on the pressure switch ensuring that the connection is made in accordance with the cable identification and the applicable wiring diagram.

F. Conclusion

(1) Remove the safety clips and reset the circuit breakers previously tripped.

R (2) Carry out a static function test on the reheat detection system in accordance with 76-15-03, Adjustment/Test.

EMERGENCY SHUT-DOWN - DESCRIPTION AND OPERATION

1. General

The LP shaft signal system, comprising a signal generating mechanism, a cylinder and piston assembly and a pull-off mechanism, acts between the rear of the LP compressor shaft and the quick shut-down valve in the distribution block of the engine fuel system. The action of the quick shut-down valve on the fuel system is described in 73-20-00.

2. Signal Generating Mechanism (Ref. Fig. 001) (detail A)

A signal tube is located co-axially inside the LP shaft and attached to it at the front end. A running nut with right-hand and left-hand helical splines on its inner and outer diameters respectively engages corresponding helical splines on the LP compressor shaft and the signal tube. A lever is set with one end at the rear face of the running nut. A cable attached to the other end of the lever, connects to a centre cable which in turn is attached to the piston of the cylinder and piston assembly.

3. Thermal Expansion Compensating, Cylinder and Piston Assembly (Ref. Fig. 001) (detail B)

The thermal expansion piston and cylinder assembly consists of a cylinder enclosing a spring-loaded piston and a catch plate.

The spring loads the piston to a preset point in the cylinder and holds the centre and rear cables to the lever in tension. The catch plate is connected by the front cable to the pull-off mechanism in the distribution block. The cable passes through a hole in the piston which is of smaller diameter than the catch plate.

A cold clearance, set between the piston hole flange and the catch plate, gives the lost motion required to compensate for thermal expansion.

4. Pull-off Mechanism (Ref. Fig. 001) (Detail C)

The mechanism consists of a pull-off plunger, located within a fixed sleeve on the distribution block engaged with the quick shut-down valve linkage, and a secondary plunger incorporating a locking device.

The operating cable is connected to the secondary plunger located in the bore of the pull-off plunger. The secondary plunger is retained by a pin secured in the pull-off plunger wall and engaged with slots in the wall of the secondary plunger. The pin also secures a spring retainer in the bore

CR 31664 009

EXHAUST DIFFUSER
R.H. AND L.H. HELICES
HELICAL SPLINED NUT
STOP
A
C
B
SIGNAL TUBE
A
LEVER
L.P. COMPRESSOR SHAFT
CABLE

PISTON FLANGE
CATCH PLATE
SLIDING GUARD
CYLINDER
SPRING
B

SECONDARY PLUNGER
CIRCLIP
PULL-OFF PLUNGER
PIN
GUIDE PIN
SLEEVE
RESET PLUNGER
QUICK SHUT-DOWN
VALVE LINKAGE
C
DETENT PLUNGER
SHROUD

CMR 76 20 00 0 AAMO

Signal System and Quick Shut-down Valve
Figure 001

R

CR 31663/00A

PULL-OFF PLUNGER
SECONDARY PLUNGER
PLUNGER LOCKED
CABLE
SPRING RETAINER
LINKAGE LOCKED-QUICK SHUT-DOWN VALVE CLOSED
SLOT FORWARD
PIN

MECHANISM ARMED

PLUNGER UNLOCKED

SECONDARY PLUNGER REARWARD IN PULL-OFF PLUNGER

MECHANISM OPERATING

PULL-OFF PLUNGER REARWARD

LINKAGE LOCKED-QUICK SHUT-DOWN VALVE OPEN

MECHANISM TRIPPED

CMR 76 20 00 0 BAMO

Pull-off Mechanism Operation
Figure 002

of the secondary plunger which traps a spring within the bore end.

The locking element is provided by balls held in holes in the pull-off plunger wall. The secondary plunger has a stepped
R diameter coincident with the balls. A groove in the bore of
R the sleeve accommodates the ball protrusion when the larger
R diameter is in contact.

Protection against inadvertent opening of the valve is provided by the geometric setting of the linkage and the
R locking action of the secondary plunger. Radial movement of
R the pull-off plunger is prevented by a guide pin in engagement
R with a slot in the sleeve.

A reset plunger, retained by a shroud, is assembled with the plungers to facilitate re-arming the mechanism during mainten-
R ance. A retaining circlip (S.B.OL.593-73-8634-66) at the rear
R of the sleeve prevents displacement of the plunger mechanism
R when the signal system is disconnected.

5. Operation of System (Ref. Fig.001 and 002).

Should the LP shaft twist or fail, the signal generating mechanism operates. Movement of the shaft end relative to the signal tube end will occur and cause the nut to move rearward rapidly in response to the thrust of the helices. The nut acts on the signal system lever which, in turn transmit a pull through the operating cables of the system.

The initial movement of the lever, transmitted by the rear and centre cables, causes the piston of the cylinder and piston assembly to move rearward and take up the clearance between the piston flange and catch plate. Further movement of the lever is then transmitted to the pull-off mechanism by the front cable.

The initial pull of the operating cable moves the secondary plunger within the pull-off plunger to the limit of the slotted hole. The reduced diameter on the secondary plunger end than allows the locking balls to disengage from the locking grooves in the sleeve.

With the pin abutting the end of the hole, the continuing pull of the cable on the secondary plunger is transmitted through the pin to the pull-off plunger which then moves
R toward the tripped position.

The pull-off plunger acts on the quick shut-down valve linkage, breaks the geometric lock and causes the valve to open and shut down the engine. Once open, the linkage pin

rests on the flat of the plunger and the valve is locked fully open while a detent plunger prevents return movement of the pull-off plunger.

The quick shut-down valve and pull-off mechanism can only be reset manually during maintenance.

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LP SHAFT SIGNAL SYSTEM - ADJUSTMENT/TEST

1. Tools and Equipment

   Turning tool, to rotate piston for check ... PE.19644

2. Signal System Adjustment/Test Procedure

   A. Prepare for Adjustment of Thermal Expansion Compensating, Cylinder Piston Assembly.

      (1) Open engine bay rear doors on engines No.1 and No.3 and rear lower doors on engines No.2 and No.4 (Ref.71-00-00, Servicing).

   B. Check and Adjust Cylinder and Piston Assembly (Ref. Fig. 501)

      (1) Ensure that the engine is cold, that all work has been completed on the signal system and that the valve operating mechanism has been re-armed (Ref.76-21-01, Removal/Installation).

      (2) Check piston setting.

         (a) Slacken bolt securing strap at front of cylinder, disengage lug and move strap assembly rearwards to expose observation holes of cylinder and piston.

         (b) Check visually through coincident holes of cylinder and piston and note position of indicator groove of catch plate. If observation hole of piston is not coincident with that of cylinder, slacken nut and bolt of sliding guard strap, remove flange retaining bolts and move sliding guard to front end of cylinder and then use tool to turn piston to required position.

         (c) When correctly set, indicator groove of catch plate is in line with rear edge of observation hole in piston.

      (3) Should setting be incorrect, adjust cable and set piston position in relation to catch plate.

         (a) If not already done, slacken nut and bolt of sliding guard strap, remove flange retaining bolts and move sliding guard to front end of cylinder.

CR 31329/00B

STRAP ASSEMBLY
SLIDING GUARD
A
B
CYLINDER
FIXED GUARD
PISTON
HOLES FOR TURNING TOOL
LOCKNUT
PISTON NUT
CATCHPLATE INDICATOR GROOVE
CATCHPLATE
A
B

CMR 76 21 00 5 AAM0

Check and Adjustment of Piston Setting
Figure 501

R

(b) Release cable locknut, hold cable and piston against turning, and turn piston nut, held by retaining ring, in the required direction on cable unit threaded end until indicator groove of catch plate is aligned.

R (c) Apply lubricant A and torque-tighten locknut
R to 100 lbf in (11,5 Nm). Wire-lock locknut to piston nut.

(d) Recheck and ensure piston setting is correct.

(4) Move sliding guard rearward to abut flange of fixed guard. Apply lubricant B and secure sliding guard to fixed guard with two nuts and bolts torque-tightened to between 28 and 32 lbf in (3,2 and 3,6 Nm).

R (5) Apply lubricant A and secure sliding guard clamping
R strap with nut and bolt torque-tighten to 100 lbf in
R (11,5 Nm).

(6) Position cylinder strap assembly to engage lug.
R Apply lubricant A and torque-tighten clamping screw
R to 40 lbf in (4,5 Nm).

(7) Close the engine bay doors (Ref.71-00-00, Servicing).

LP SHAFT SIGNAL SYSTEM
- INSPECTION/CHECK

1. General

This chapter details the procedures to determine the force required to operate the quick shut-down valve plunger mechanism via the thermal expansion cylinder and piston assembly (Ref.S.B.OL.593-76-18) in paragraph 3, and the inspection procedure for the cables in paragraph 4.

Details of approved servicing and storage materials quoted in this chapter are given in 70-00-01.

2. Tools and Equipment

Spring balance, range 0 to 200 lb (0 to 90 kg)	-
Reset tool, to arm valve mechanism	PE.27252
Rigging pin, for check of secondary plunger ...	S3S 1566-9000
Turning tool, to hold/turn piston for check	PE.19644

3. Carry Out Check

A. Prepare for Check.

(1) Open engine bay rear doors (Ref.71-00-00, Servicing).

B. Trip Quick Shut-down Valve Plunger Mechanism and Check for Operation Within Specified Limits.

(1) Check reset plunger for free movement.

(a) Check that reset plunger is free to move sideways in and out of shroud slot by approximately 0.010 to 0.020 in. (0,25 to 0,50 mm).

(b) If movement is not sufficient, slacken bolts securing shroud to distribution and dump valve and turn shroud the minimum amount to free the plunger and allow movement to be obtained. Temporarily re-tighten bolts and check that reset plunger remains free.

WARNING: WASH HANDS AFTER CONTACT WITH LUBRICANT G ON SIGNAL SYSTEM

COMPONENTS. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

CAUTION: DO NOT PULL SIGNAL SYSTEM CABLE WHEN DISCONNECTING. ENGINE SHUT-DOWN MECHANISM WOULD BE DISTURBED.

R (2) Detach centre cable from rear cable.

(a) Remove nuts and bolts securing rear block to bracket.

(b) Slacken cable at cylinder and piston adjustment sufficiently to allow disengagement of rear block (Ref.Fig.602). Support block while slackening adjustment and do not fully unscrew.

(b1) Slacken sliding guard clamping bolt, remove guard retaining nuts and bolts and slide guard clear of piston nut.

(b2) Release locknut on piston nut.

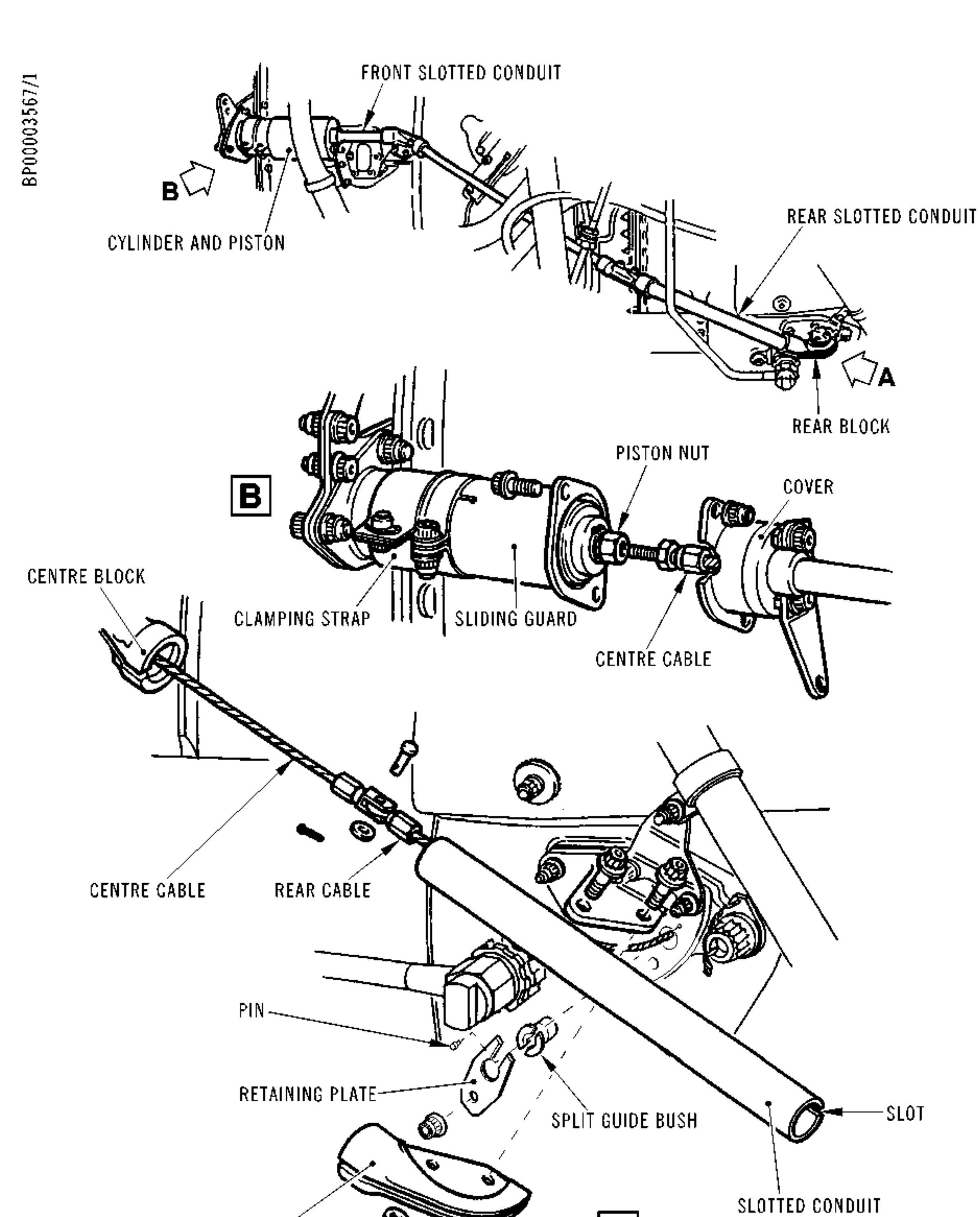
(b3) Turn piston nut to slacken cable while disengaging rear block (Ref.para.(c)) and note exact amount turned. Restrain cable and hold piston with turning tool while turning piston nut.

(c) Without pulling cable and with slotted conduit compressed and pressed fully towards centre block, turn rear block, disengage from cable and detach from conduit end.

(d) Compress forward end of conduit and withdraw from centre block.

(e) Make use of slot in the conduit and slide it off the cable and expose the cable connection.

Figure 601 Deleted



R
R
R
R
R

Cable Disconnection Detail
Figure 602

(f) Reset the cable adjustment to original position in accordance with number of turns noted when slackening.

(g) Remove split pin, washer and shouldered pin securing centre cable to rear cable and separate the ends.

R (3) Insert a tool through the holes provided for the shouldered pin in the centre cable end fitment and attach spring balance.

R (4) Trip the mechanism.

(a) Observe indicator reading and apply a progressively increasing rearward pull on the centre cable until reset plunger trips and exposes the red indicator. Pull in line with the cable run axis within a maximum limit of 170 lb (77 kg).

(b) Record the force indicated on the spring balance as the mechanism trips as FORCE A.

(c) If the plunger mechanism does not trip within the pull limitation, investigate and rectify the defect and resume the trip/check procedure.

R (5) Establish the force required to operate thermal expansion cylinder and piston assembly.

(a) Slacken bolt securing strap at front of cylinder, disengage lug and move strap assembly rearwards to expose front cable through the observation holes of cylinder and piston.

(b) Apply a progressively increasing rearward pull on centre cable in line with cable run axis, until the front cable, viewed through observation holes, is seen to just move and note the force registered on the spring balance. Record as FORCE B.

R (6) Calculate the force required to trip the reset plunger and record as FORCE C.

FORCE A - FORCE B = FORCE C

Acceptable limits:

FORCE B		56 lb (25 kg) maximum
FORCE C		)50 lb (23 kg) maximum
		) 8 lb (4 kg) minimum

R (7) Remove tool/spring balance from cable end fitment.

R (8) If a satisfactory check for operation was carried out and no further check is required (Ref.para.C), reconnect and re-arm as detailed in paragraphs D and E.

C. Rectification.

(1) If FORCE B limit is exceeded:

(a) Strip the thermal expansion cylinder and piston assembly, clean with kerosene or white spirit, air dry components, apply lubricant G sparingly to the cylinder bore and piston and reassemble (Ref.76-21-01, Removal/Installation).

(b) Re-arm and recheck the system as detailed in paragraphs E and B.

(2) If FORCE C limit is exceeded:

(a) Re-arm and recheck the system as detailed in paragraphs E and B to confirm defect.

(b) If FORCE C limit is exceeded for the second time renewal of the distribution and dump valve will be required.

(3) If rectification was carried out, or replacement thermal expansion cylinder and piston assembly or distribution and dump valve was installed, re-arm and recheck the system as detailed in paragraphs E and B.

D. Reconnect System.

(1) If pull-off checks were satisfactory, connect cable as follows. Do not connect cable at this stage if further check is to be carried out.

(a) Connect centre cable to rear cable and secure with shouldered pin, washer and split pin

WARNING: WASH HANDS AFTER USING LUBRICANT G. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

(b) Apply lubricant G liberally by brush to cable and connection.

(c) Slide conduit over cable and connection, compress end and engage fully in bore of centre block.

(d) Engage cable with guide portion of block and, with conduit end compressed, engage it fully with rear block bore.

R (e) Pre-SB.OL.593-76-9043-72. Ensure that the cable guide bush halves are correctly located in the hole behind the rear block, align rear block and bracket attachment holes and insert the two attachment bolts.

(f) SB.OL.593-76-9043-72. Ensure that the locating pin, the cable guide bush halves, the retaining plate and attachment bolt are installed correctly. Align rear block and bracket attachment holes and insert the two attachment bolts.

(g) With lubricant B applied secure rear block to bracket with nuts and bolts torque-tightened to between 67 and 73 lbf in (7,6 and 8,2 Nm).

WARNING: WASH HANDS AFTER USING LUBRICANT G. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

(h) Apply lubricant G liberally by brush to cable at rear block and guide bush.

(j) Turn conduit until slots are out of alignment with slots in adjacent blocks.

(2) Check piston setting and secure strap.

(a) Check visually through coincident holes of cylinder and piston and check that indicator groove of catch plate is in line with rear edge of observation hole in piston.

(b) If setting is correct, torque-tighten locknut
R with lubricant A applied to 100 lbf in (11,5
R Nm). Wire-lock locknut to piston nut.

(c) If setting is not correct, adjust piston in relation to catch plate as detailed in 76-21-00, Adjustment/Test.

(d) Position cylinder strap to engage lug. Apply lubricant B to clamping screw and torque-
R tighten to 40 lbf in (4,5 Nm).

E. Re-arm the System.

CAUTION: THE RESET PLUNGER INCLUDES A RED INDICATOR MARK WHICH IS DESIGNED TO BE OUT OF SIGHT WHEN THE SYSTEM HAS BEEN SAFELY RESET. THIS MARK IS DIFFICULT TO VIEW AND CAN DISCOLOUR WITH USE. IT CANNOT BE REGARDED AS A RELIABLE METHOD OF ENSURING THAT THE SYSTEM IS SET CORRECTLY. ONLY SUCCESSFUL USE OF THE RIGGING PIN WILL ENSURE THAT THE VALVE OPERATING MECHANISM IS IN THE LOCKED POSITION.

(1) Arm trip mechanism.

(a) Engage reset tool with recess at rear of reset plunger and press it fully in

(2) Check that the valve operating mechanism is in the locked position.

(a) Remove nuts and bolts securing shield front adapter to shroud.

(b) Slacken bolts securing shroud to distribution and dump valve.

(c) Turn shroud and align the slots.

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(d) Insert the rigging pin (Ref. Fig. 603) and press fully home through the alignment holes of shroud, plunger sleeve, pull of plunger and secondary plunger. Pin must press fully home so that all axial movement of its sleeve is taken up for check to be acceptable.

<u>NOTE:</u> If the pin does not pass through the pull-off plunger alignment hole, the plunger may have been pressed in slightly more than the normal set position. Light rearward pressure on the reset plunger may be necessary.

(e) Remove rigging pin and turn shroud to full extent of slotted flange to close off slots.

<u>CAUTION:</u> ENSURE THAT CABLE IS NOT PULLED AFTER REMOVAL OF RIGGING PIN. A PULL WILL UNLOCK SECONDARY PLUNGER.

(f) Remove each bolt securing shroud to distribution and dump valve separately, apply lubricant A and replace bolt.

(g) Apply lubricant A and assemble the two bolts and nuts to the shield front flanged adapter to shroud flanges.

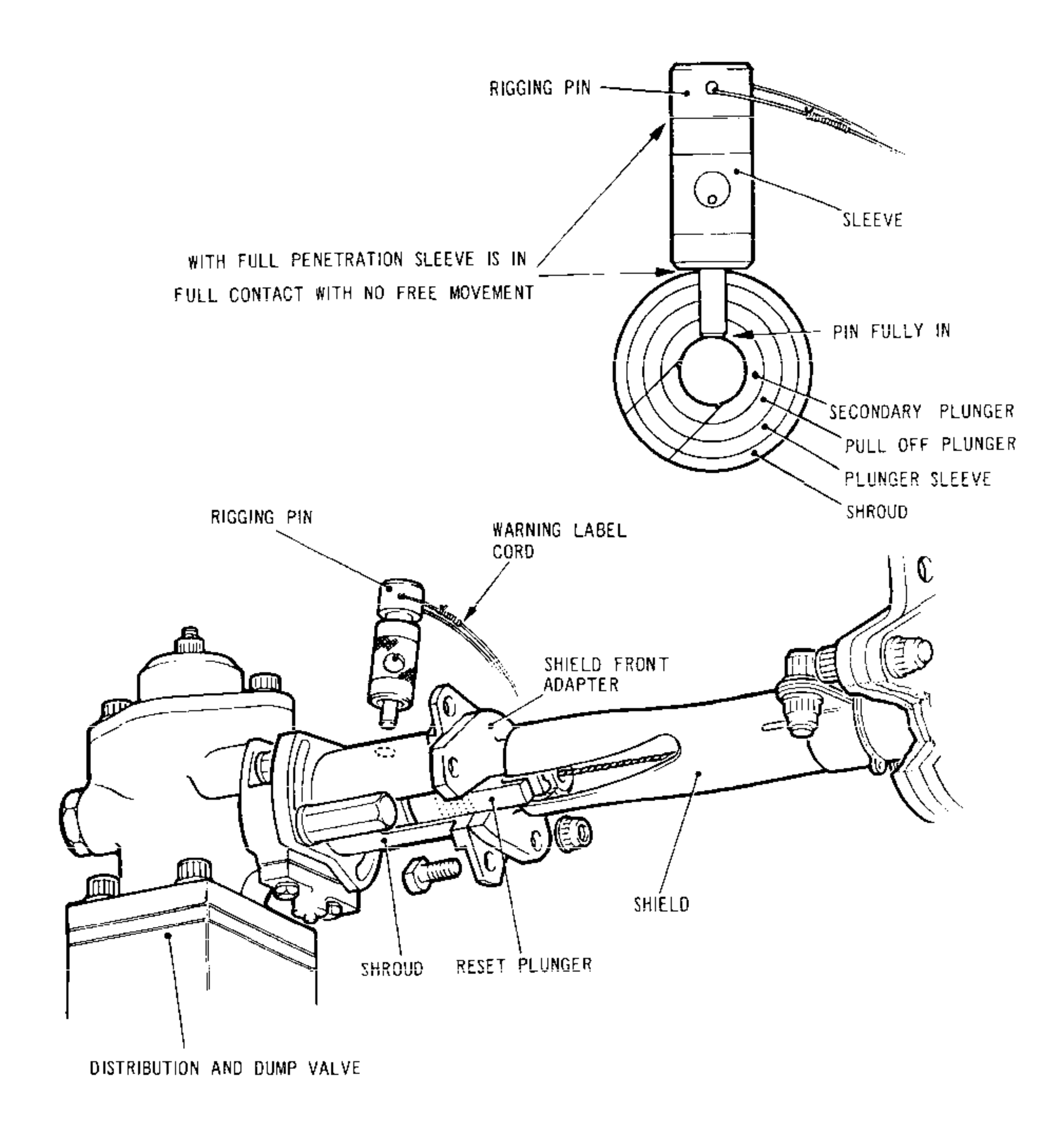
(h) Check that locking torque of bolts retaining shield to shroud and shroud to distribution and dump valve is not less than 2 lbf in. (0,2 N.m).

(j) Torque-tighten shield to shroud retaining nuts and bolts to 40 lbf in. (4,5 N.m).

(k) Check that reset plunger is free to move sideways in and out of the slot by approximately 0.010 to 0.020 in. (0,25 to 0,50 mm) and progressively tighten shroud to distribution and dump valve bolts to 40 lbf in. (4,5 N.m) while ensuring that the reset plunger remains free. If free movement is lost, turn shroud the minimal amount away from the end of flange slot to a position that will restore the required movement when the bolts are tight.

F. Complete the Procedure

(1) Close engine bay doors (Ref.71-00-00, Servicing).



Re-arm Details and Alignment Check of
Pull-off Plungers
Figure 603

4. Cable Inspection/Check

B A. The LP shaft signal system cables consist of seven strands
RB each comprised of 14 wires. The system comprises of solid
B cast iron guide blocks which the cables pass over. No
B rollers are fitted.

RB B. Examine cables.

B (1) Materials.

B Lubricant B. Aeroshell grease 8.Stores code NFLA 6007.
B Lubricant G. P.B.C. Stores code NFLA 6177.

B (2) Procedure.

B (a) Open engine bay doors (Ref.71-00-00 Servicing).

B (b) Detach the centre cable from the rear cable.

B CAUTION: CARE SHOULD BE TAKEN NOT TO TRIP THE LP
B SHAFT SIGNAL WHEN CARRYING OUT THE
B FOLLOWING PROCEDURE.

B (b1) (Ref.Fig.606). Remove nuts and bolts
B securing rear block to bracket and
B guard plate.

B (b2) Compress slotted conduit ends and press
B rear block toward centre block to take
B up full depth of conduit housings and
B remove rear block, turning it to
B disengage cable as conduit is disengaged.

B (b3) Compress forward end of conduit,
B disengage from centre block and make use
B of slot to slide it off the cable.

B (b4) Remove split pin, washer and shouldered
B pin securing centre cable to rear cable.

B (b5) Remove bolts securing centre block guard
B plate to centre block and centre block to
B engine carcase and remove centre block.

B (b6) Remove centre slotted conduit.

B (3) Inspection.

Figure 604 Deleted

Figure 605 Deleted

BP00003568/1

CYLINDER/PISTON
FRONT SLOTTED CONDUIT
FRONT BLOCK
CENTRE BLOCK
REAR SLOTTED CONDUIT
REAR BLOCK
B
C
D
A
CENTRE SLOTTED CONDUIT

BASE PLATE
FIXED GUARD
FRONT CABLE
B
COVER

FRONT BLOCK GUARD PLATE
C
SLOTTED CONDUIT

SLOTTED CONDUIT
D
CENTRE BLOCK GUARD PLATE

CENTRE CABLE
BRACKET
REAR CABLE
PIN
RETAINING PLATE
SPLIT GUIDE BUSH
A
REAR BLOCK
REAR SLOTTED CONDUIT

R
R
R
R
R
R

Cable Assembly Detail
Figure 606

B

RB (a) Examine each wire along the complete length of the cable. Flexing the cable will help in finding any breakages.

RB (b) Reject a cable if it has any broken wires.

B (4) Assembly

B (a) Apply lubricant B to all nuts and bolts, studs etc. Apply lubricant G liberally by brush to the cables.

B <u>WARNING:</u> WASH HANDS AFTER USING LUBRICANT G. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

B (b) Refit centre slotted conduit. Compress ends to engage in front guide block.

B (c) Refit bolts securing centre block to engine carcase at the same time engaging centre slotted conduit to centre guide block. Tighten bolts loosely.

B (d) Refit centre block guard plate.

B (e) Connect centre cable to rear cable and secure with shouldered pin, washer and split pin.

B (f) Slide the rear slotted conduit over the cable and compress the forward end and engage with the centre guide block.

R (g) Pre-SB.OL.593-76-9043-72. Ensure that the matched pair of guide bush halves are correctly installed in the hole in the bracket mounted on the turbine exhaust diffuser case.

R (h) SB.OL.593-76-9043-72. Ensure that the matched
R pair, guide bush halves, with the locating pin
R and retaining plate, are correctly installed in
R the hole in the bracket mounted on the turbine
R exhaust diffuser case.

R (j) Simultaneously engage cable with slot of rear block and, with conduit end compressed, engage block with conduit end and turn block into position on mounting bracket.

R (k) Align block and bracket attachment holes, insert two bolts and secure block to bracket with nuts. Attach guard plate to rear guide block.

R (l) Torque-tighten all nuts to between 67 and 73 lbf-in. (7,6 and 8,2 N.m).

R (m) Turn conduit slots until they face downward.

R (n) Re-rig the system IAW 76-21-02, Para.E. This rigging procedure must be carried out even if the cables have not been replaced.

5. <u>Inspect Conduits</u>

A. To check if the cable conduits are worn to a point where there is a danger of them moving sideways and damaging the cables the following checks must be carried out on both ends of conduits.

(1) Check the diametral play between every conduit end and its mounting. Wherever the play is more than 0.015 in. (0,4 mm) in any direction, remove the conduit concerned. Refer to 76-21-01 for removal procedures.

(2) Inspect the ends of the dismantled conduit for wear. If any conduits are worn to less than 50% of their original thickness at any point, reject them and replace with new parts.

Carefully inspect the whole length of the centre cable and exposed portion of rear cable for evidence of broken strands. This usually occurs where the centre cable passes over the guide blocks and the rear cable exits the exhaust diffuser and passes over the rear guide block. Pay particular attention to where the rear cable passes through the half bushes in the exhaust diffuser.
Where broken strands are suspected, bend the cable into a loop. Avoid kinking the cable during inspection. Estimate the total number of broken wires at any one point.

Centre cable - no more than 4 wires broken over a 1 1/2" length.
Rear cable - no more than 2 wires broken over a 1 1/2" length.

P/No. of centre cable - B407987
P/No. of rear cable - B496227

(4) Assembly

(a) Apply lubricant B to all nuts and bolts, studs etc. Apply lubricant G liberally by brush to the cables.

<u>WARNING:</u> WASH HANDS AFTER USING LUBRICANT G. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

(b) Refit centre slotted conduit. Compress ends to engage in front guide block.

(c) Refit bolts securing centre block to engine carcase at the same time engaging centre slotted conduit to centre guide block.
Tighten bolts loosely.

(d) Refit centre block guard plate.

(e) Connect centre cable to rear cable and secure with shouldered pin, washer and split pin.

(f) Slide the rear slotted conduit over the cable and compress the forward end and engage with the centre guide block.

B (g) Ensure that the matched pair of guide bush halves
B are correctly installed in the hole in the brac-
B ket mounted on the turbine exhaust diffuser case.

B (h) Simultaneously engage cable with slot of rear
B block and, with conduit end compressed, engage
B block with conduit end and turn block into
B position on mounting bracket.

B (i) Align block and bracket attachment holes,
B insert two bolts and secure block to bracket
B with nuts. Attach guard plate to rear guide
B block.

B (j) Torque tighten all nuts to between 67 and 73
B lbf-in.

B (k) Turn conduit slots until they face downward.

B (l) Re-rig the system IAW 76-21-02, Para.F. This
B rigging procedure must be carried out even if
B the cables have not been replaced.

CYLINDER PISTON SECTION WITH FRONT AND CENTRE CABLE ASSEMBLY - REMOVAL/INSTALLATION

1. General

This chapter covers the signal system from the quick shut-down plunger mechanism to the front connection on the rear cable assembly, and deals with its removal as a complete assembly in paragraph 3. Removal and installation procedures apply to S.B.OL.593-76-8518-24, 76-8523-25 and 76-7234-34 standard engines and give the procedures applicable to S.B.OL.593-76-8570-26 and 76-8582-28 standard engines only.

Removal and installation procedures for the centre cable assembly as a separate item are given in paragraph 4 and state the procedural changes necessary in respect of the various S.B. standards.

Details of approved servicing and storage materials quoted in this chapter are given in 70-00-01.

R Lubricant T (Guardian Chain Lubricant 1) is obtainable from
R Guardian Barrier Lubricants, Unit 57, I-MEX Business Park,
R Upper Vikiers Street, Wolverhampton, WV2 4NU.

2. Tools and Equipment

Spring compressor	PE.29938
Reset tool, to arm valve mechanism...	PE.27252
Rigging pin, for check of secondary plunger ...	S3S15669000

3. Piston and Cylinder Assembly Complete with Front and Centre Cables - Removal/Installation

A. Prepare to Remove Cables, Piston and Cylinder Assembly.

(1) Open engine bay rear doors (Ref.71-00-00, Servicing).

CR 31127/00C

RETAINING RING
CLAMP
SHIELD
RESET PLUNGER
DISTRIBUTION AND DUMP VALVE
A
CMR 76 21 01 4 AAMO
CABLE
SHIELD (REARWARD)
SHROUD
SHIELD FRONT ADAPTER
GUIDE BUSH HALVES
CLAMP (SLACKENED)
RED INDICATOR MARK
SECONDARY PLUNGER
RESET PLUNGER

Front Cable Disconnection Details
Figure 401

R

B. Remove Cylinder and Piston with Cable Assemblies.

WARNING: WASH HANDS AFTER CONTACT WITH LUBRICANT G ON SIGNAL SYSTEM COMPONENTS. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

(1) Trip the quick shut-down valve plunger mechanism.

(a) Disconnect centre cable from rear cable, trip the mechanism and check operation as detailed in 76-21-00, Inspection/Check, paragraph 3.B. (2).

(b) If the acceptable limits of operation are not met, rectify defect concurrent with the following procedures.

(2) Disconnect front cable from valve plunger mechanism (Ref.Fig.401).

(a) Remove nuts and bolts securing shield front adapter to shroud.

(b) Slacken the shroud locking bolts, turn shroud until withdrawal slots are aligned and withdraw the reset plunger.

(c) Remove retaining ring rearward from locating groove and leave in position on shield rear adapter.

(d) Slacken clamp retaining bolt and slide shield rearward to abut cylinder and piston assembly.

(e) Disengage cable and turn shield to clear attachment flange.

R

Figure 402. Deleted

BP00003569/1

CYLINDER/PISTON
FRONT SLOTTED CONDUIT
FRONT BLOCK
CENTRE BLOCK
REAR SLOTTED CONDUIT
REAR BLOCK
B
C
CENTRE SLOTTED CONDUIT
D
A
BASE PLATE
FIXED GUARD
FRONT BLOCK GUARD PLATE
FRONT CABLE
B
COVER
C
SLOTTED CONDUIT
CENTRE CABLE
SLOTTED CONDUIT
D
BRACKET
REAR CABLE
PIN
CENTRE BLOCK GUARD PLATE
A
RETAINING PLATE
SPLIT GUIDE BUSH
REAR SLOTTED CONDUIT
REAR BLOCK

Centre Cable Disconnection Details
Figure 403

CR 31129/00B

AIR VENT TUBE

AIR TUBE TO FUEL HEATER VALVE

A

B

AIR VENT TUBE

HP COMPRESSOR DIFFUSER CASE REAR FLANGE

AIR VENT TUBE SUPPORT BRACKET

BASEPLATE

BASE PLATE ATTACHMENT NUTS

CYLINDER

SHIELD

SHIELD REAR ADAPTER

A

CMR 76 21 01 4 DAMO

REAR MOUNTING BRACKET

COVER

MOUNTING BRACKET FOR AIR VENT TUBE AND AIR PIPE TO FUEL HEATER VALVE

B PRE S.B. OL.593-76-26 AND 76-28

REAR MOUNTING BRACKET

COVER

MOUNTING BRACKET FOR AIR VENT TUBE AND AIR PIPE TO FUEL HEATER VALVE

B S.B. OL.593-76-26 AND 76-28

Piston and Cylinder Assembly Mounting Brackets
Figure 404

R

R (3) Detach piston and cylinder assembly (Ref.Fig.404).

NOTE: Centre cable disconnected from rear cable for previous tripping check.

(a) Remove nuts and bolts securing rear block to bracket.

(b) Compress slotted conduit ends and press rear block toward centre block to take up full depth of conduit housings.

(c) Remove nut and bolt and detach guard plate at the front block and at the centre block.

(d) Turn slots of conduits to align with slots of centre and rear block.

(e) Remove two nuts and bolts securing air vent tube support bracket to baseplate.

(f) Remove three bolts securing rear end of cylinder assembly to engine mounted bracket.

(g) Remove nuts securing baseplate to HP compressor diffuser case rear flange.

(h) Support assembly, compress end of slotted conduit and disengage assembly cover from conduit end.

(j) Guide centre cable through conduit slots and remove assembly complete with front and centre cables.

(k) Temporarily retain the cover to the assembly.

R (4) If front and/or centre blocks are to be removed, proceed as follows:

(a) Remove two remaining nuts and bolts and remove each block in turn, disengaging slotted conduits at the same time.

C. Detach Cables from Piston and Cylinder (Ref.Fig.405).

WARNING: WASH HANDS AFTER CONTACT WITH LUBRICANT G ON SIGNAL SYSTEM COMPONENTS. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

(1) Slacken nut and bolt securing clamping strap on sliding guard then move sliding guard together with fixed guard away from cylinder.

(2) Slacken locknut and unscrew centre cable from nut at piston end.

(3) Separate centre cable from sliding and fixed guards
R and slide off the cover.

(4) Assemble spring compressor to piston and cylinder.

CAUTION: DO NOT UNSCREW BASEPLATE NUTS AND BOLTS UNLESS SPRING COMPRESSOR IS INSTALLED AND BOLT TENSION IS RELIEVED.

(a) Remove spring compressor spindle from location sleeve nut.

(b) Hold piston nut against turning and screw in spindle fully.

(c) Assemble location sleeve to spindle and screw thrust nut until dogs locate on the cylinder.

(d) Continue to screw nut until the spring starts to compress and load is removed from baseplate.

(5) Remove bolts and nuts securing shield rear flanged adapter and baseplate to cylinder.

(6) Remove spring compressor.

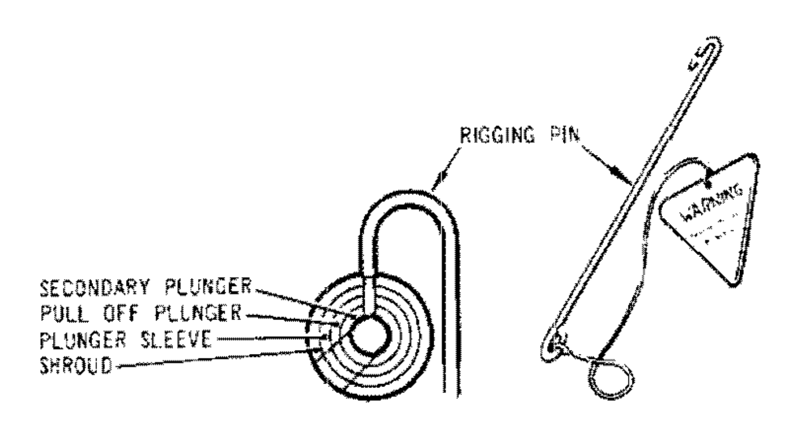
(a) Unscrew location sleeve thrust nut from spindle until spring is fully extended.

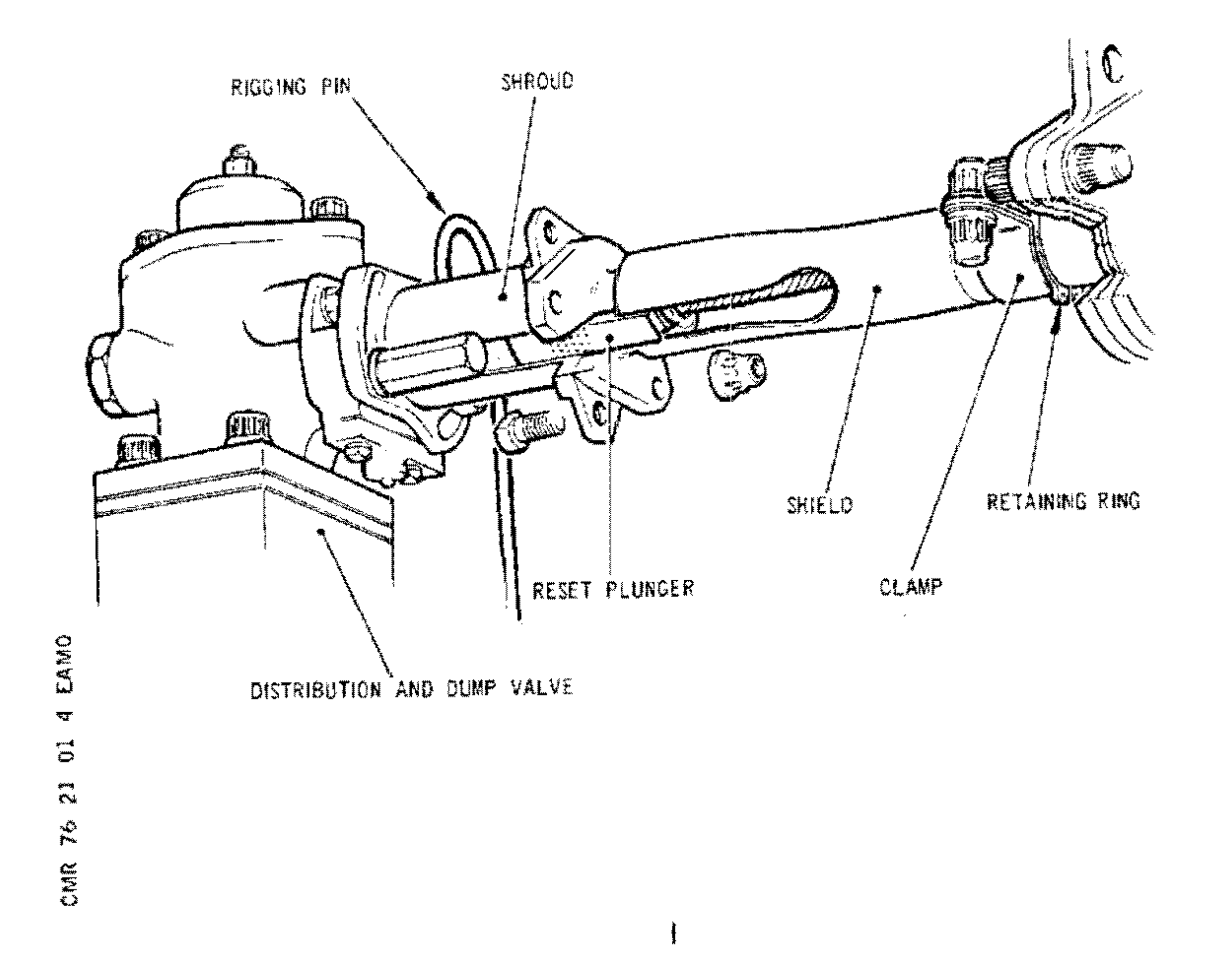
(b) Hold piston nut against turning, unscrew spindle and remove spring compressor.

(7) Separate cylinder and spring from piston.

(8) Remove nut securing catch plate and detach front cable complete with shield.

CR 31(3)/00B





CMR 76 21 01 4 EAMO

Piston and Cylinder Assembly and Spring
Compressor Installation
Figure 405

R

(9) Slip catch plate out through slot in cylinder.

(10) Examine centre cable for broken wires as detailed in 76-21-00, Inspection/Check.

(11) If front cable only is to be renewed detach from shield assembly. Retain front and rear guide bushes, when removed, as matched pairs for assembly with the new cable.

(a) Remove guide bush retaining spring pins and withdraw bushes from front and rear shield flanged adapters in turn.

(b) Separate cable from shield assembly.

D. Assemble Cables to Piston and Cylinder (Ref.Fig.405).

(1) If front cable has been separated from shield, prepare front cable assembly as follows:

WARNING: WASH HANDS AFTER USING LUBRICANT G. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

R (a) Immerse the cable in lubricant T, allow to soak, and then drip dry.

R (b) Position rear adapter over cable, insert rear guide bushes and secure to adapter with spring pin.

R (c) Position retaining ring loosely on rear adapter, pass shield assembly over cable and locate shield on rear adapter.

R (d) Position front adapter over cable, insert front guide bushes and secure to adapter with spring pin.

(2) Apply lubricant B to nuts and bolts.

(3) Assemble front cable to piston.

(a) Apply lubricant G to the cable and baseplate central bore.

(b) Assemble baseplate to shield assembly and position piston over cable end.

(c) Assemble catch plate to cable end through the piston slot and secure with retaining nut torque-tightened to between 67 and 73 lbf in. (7,6 and 8,2 N.m).

(4) Assemble spring compressor to cylinder and piston assembly and secure cylinder to baseplate and shield rear flanged adapter.

(a) Apply lubricant G sparingly to the cylinder rear end small diameter bore and the piston front end large diameter.

(b) Remove spring compressor spindle from location sleeve.

(c) Hold piston nut against turning and screw in spindle fully.

(d) Slide spring and cylinder over the piston.

(e) Assemble spring compressor location sleeve to spindle and screw thrust nut until location sleeve dogs locate on the cylinder.

(f) Continue to screw nut and compress spring until baseplate can be brought into abutment with the cylinder. Do not tighten more than is necessary for this purpose.

(g) Align bolt holes and secure shield rear adapter and baseplate to cylinder with three bolts and nuts torque-tightened to between 67 and 73 lbf in. (7,6 and 8,2 N.m).

(5) Unscrew thrust nut until spring load is no longer taken by compressor.

(6) Hold piston nut against turning, unscrew spindle and remove the spring compressor.

(7) Connect centre cable assembly to piston end.

(a) Immerse the cable in lubricant T, allow to soak and then drip dry.

(b) Pass cable end through cover bore and centre of fixed and sliding guard.

(c) Screw locknut on cable end then engage with piston nut threads to full depth of nut with
R lubricant A applied. Leave lock nut slack.

(d) Locate sliding guard together with fixed guard in approximate installed position and lightly tighten strap bolt and nut. Retain cover against end of assembly.

E. Install Cylinder and Piston with Cable Assemblies on Engine (Ref.Fig.402, 403 and 404).

<u>WARNING:</u> WASH HANDS AFTER USING LUBRICANT G. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

R (1) Apply lubricant to the attaching parts.

R (a) Apply lubricant A to front and centre block
R bolts and nuts.

R (b) Apply lubricant A to bolts and nuts for front
R and centre block guard plates.

R (c) Apply lubricant B to the other bolts and nuts.

(2) Ensure retaining ring is loosely positioned on rear shield adapter, clamp retaining bolt is slack and shield is against cylinder.

(3) Attach piston and cylinder assembly and retain centre cable in front and centre slotted conduits and blocks.

(a) If front and centre blocks and conduits have been removed, secure them in their respective locations with two nuts and bolts.

(a1) Retain one block on its mounting bracket with two nuts and bolts lightly tightened.

(a2) Compress ends of centre slotted conduit, engage with installed block and remaining block and retain block on its mounting bracket with two nuts and bolts lightly tightened.

(a3) Engage front slotted conduit with front block.

(a4) Torque-tighten nuts and bolts on each
R block to 100 lbf in (11,5 Nm).

(b) Align slots of conduits and blocks.

(c) Slacken sliding guard strap bolt and move guards and cover forward over cylinder.

(d) Locate assembly on engine with centre cable entering conduit and block slots and baseplate attachment holes engaging HP compressor diffuser rear flange bolts.

(e) Secure baseplate to flange with nuts, torque-tightened to between 85 and 95 lbf in (9,6 and 10,7 Nm).

(f) Move guards and cover rearward, engage slotted conduit end and align holes of cover and fixed guard with rear mounting bracket holes.

(g) Secure assembly to rear mounting bracket with three bolts torque-tightened to between 67 and 73 lbf in (7,6 and 8,2 Nm).

(h) Secure air vent tube support bracket to base-plate with two nuts and bolts torque-tightened to between 67 and 73 lbf in (7,6 and 8,2 Nm).

(j) Apply lubricant G liberally by brush to the length of cable where it is in contact with front and centre blocks.

(k) Turn slotted conduits so that the slots are downwards.

(l) Assemble a guard plate to the front block and to the centre block and secure each with a nut and
R bolt torque-tightened to 100 lbf in (11,5 Nm).

(4) Connect front cable to valve plunger mechanism.

(a) Verify that quick shut-down valve mechanism is tripped to the rear and reset plunger is removed.

(b) Ensure that shield is fully rearward toward cylinder baseplate.

(c) Engage cable end with slot of secondary plunger.

(d) Insert reset plunger to retain cable, turn shroud to retain plunger.

(5) If either the distribution and dump valve or the thermal expansion cylinder and piston have been renewed, or the check during disassembly was unsatisfactory, carry out the re-arming and check procedure detailed for the operating mechanism in 76-21-00, Inspection/Check, paragraph E. and B. respectively.

(6) If check is not required or a satisfactory check has been completed, connect and re-arm the system as detailed in paragraph F.

(7) Connect centre and rear cables and install rear block.

WARNING: WASH HANDS AFTER USING LUBRICANT G. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

(a) Connect centre cable to rear cable and secure with shouldered pin, washer and split pin

(b) Apply lubricant G liberally by brush to the length of rear cable where it is in contact with the rear block and guide bush.

(c) Slide the rear slotted conduit over the cable and connection and, with end compressed, engage fully with centre block bore.

(d) Pre-SB.OL.593-76-9043-72. Ensure that the matched pair, guide bush halves are correctly installed in the hole in the bracket mounted on the turbine exhaust diffuser case.

(e) SB.OL.593-76-9043-72. Ensure that the matched pair, guide bush halves, with the locating pin and retaining plate, are correctly installed in the hole, in the bracket mounted on the turbine exhaust diffuser case.

(f) Simultaneously engage cable with slot of block and, with conduit end compressed, engage block with conduit end and turn block into position on mounting bracket.

(g) Align block and bracket attachment holes, insert two bolts and secure block to bracket with
R nuts torque-tightened to 100 lbf in (11,5 Nm).

(h) Apply lubricant G liberally by brush to cable in contact with guide bush and block.

F. Arm Trip Mechanism.

R CAUTION: THE RESET PLUNGER INCLUDED A RED INDICATOR MARK
R WHICH IS DESIGNED TO BE OUT OF SIGHT WHEN THE
R SYSTEM HAS BEEN SAFELY RESET. THIS MARK IS
R DIFFICULT TO VIEW AND CAN DISCOLOUR WITH USE. IT
R CANNOT BE REGARDED AS A RELIABLE METHOD OF
R ENSURING THAT THE SYSTEM IS SET CORRECTLY. ONLY
R SUCCESSFUL USE OF THE RIGGING PIN WILL ENSURE
R THAT THE VALVE OPERATING MECHANISM IS IN THE
R LOCKED POSITION.

(1) Rearm the system and secure the shroud as detailed in 76-21-00, Inspection/Check (Ref. para.3.E.).

(2) Secure shield and check piston/catch plate setting.

(a) Assemble retaining ring to shield rear adapter groove and slide shield rearward to abut it. Position clamp and torque-tighten clamping bolt to between 67 and 73 lbf in. (7,57 and 8,25 N.m).

(b) Adjust the piston to catch plate position and torque-tighten locknut to piston nut as detailed in 76-21-00, Adjustment/Test.

G. Complete the Installation.

(1) Close engine bay doors (Ref.71-00-00, Servicing).

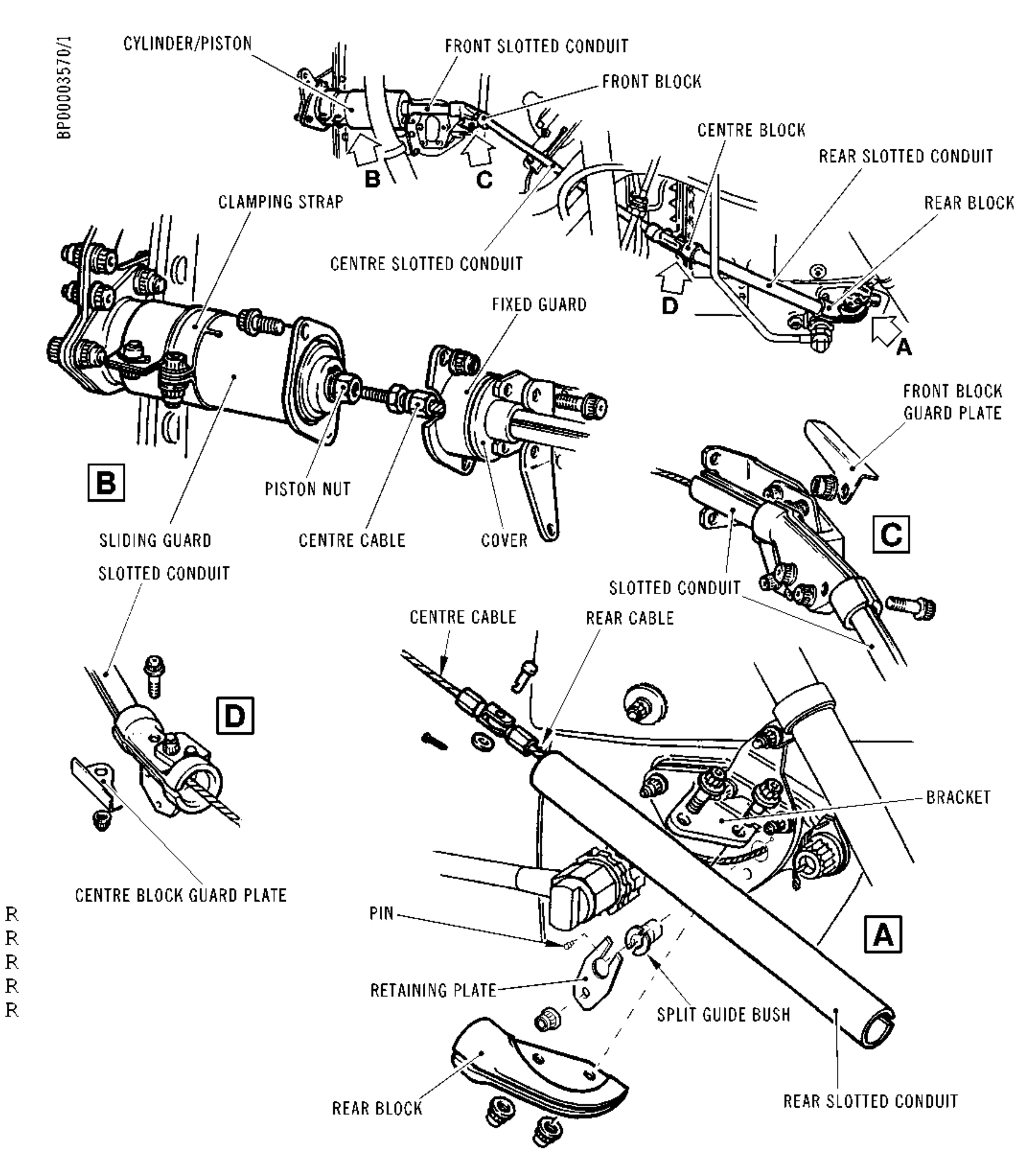
4. Inspect Conduits

A. To check if the cable conduits are worn to a point where there is a danger of them moving sideways and damaging the cables the following checks must be carried out on both ends of conduits.

(1) Check the diametral play between every conduit end and its mounting. Wherever the play is more than 0.015 in. (0,4 mm) in any direction, remove the conduit concerned. Refer to 76-21-01 for removal procedures.

(2) Inspect the ends of the dismantled conduit for wear. If any conduits are worn to less than 50% of their original thickness at any point, reject them and replace with new parts.

Figure 406. Deleted



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Centre Cable Location Detail
Figure 407

5. Centre Cable Assembly Removal/Installation (Ref.Fig.407)

WARNING: WASH HANDS AFTER CONTACT WITH LUBRICANT G ON SIGNAL SYSTEM COMPONENTS. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

A. Prepare to Remove Centre Cable Assembly.

(1) Open engine bay rear doors (Ref.71-00-00, Servicing).

B. Remove the Centre Cable Assembly.

CAUTION: DO NOT PULL SIGNAL SYSTEM CABLE WHEN DISCONNECTING. ENGINE SHUT-DOWN MECHANISM WOULD BE ACTUATED.

(1) Disconnect cable at piston and cylinder assembly.

(a) Remove nuts and bolts securing sliding guard to fixed guard.

(b) Slacken nut and bolt securing clamping strap on sliding guard, then move sliding guard forward.

(c) Slacken locknut on cable threaded end and unscrew centre cable from piston nut.

(d) Remove bolts securing fixed guard and cover to clamp block and mounting bracket, then remove fixed guard from cable.

(e) Compress end of split conduit and remove cover.

(2) Disconnect cable at rear cable connection.

(a) Remove nuts and bolts securing rear block to bracket.

(b) Compress split conduit end and remove rear block turning it to disengage cable as conduit is disengaged.

(c) Compress forward end of conduit, disengage from centre block and make use of slot to slide it off the cable and expose the connection.

(d) Remove split pin washer and shouldered pin securing centre cable to rear cable.

(3) Remove cable from engine.

(a) Remove attaching bolt and nut and guard plate at centre block and at front block.

(b) Compress and turn split conduits to align slots with slots in blocks.

(c) Withdraw cable through aligned slots.

(4) Examine cable for broken wires as detailed in 76-21-00, Inspection/Check.

(5) If removal of the front and centre blocks and slotted conduits is required, remove the attachment nuts and bolts at each of the blocks and progressively detach blocks and conduits from the engine.

D. Install Centre Cable Assembly.

WARNING: WASH HANDS AFTER USING LUBRICANT G. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

(1) Ensure that the cable meets the requirements detailed in 76-21-00, Inspection/Check.

R (2) Apply lubricants.

R (a) Immerse the cable in lubricant T, allow to soak
R and then drip dry.

R (b) Apply lubricant A to front and centre block
R bolts and nuts.

R (c) Apply lubricant A to bolts and nuts for front
R and centre block guard plates.

R (d) Apply lubricant B to the other bolts and nuts.

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R

(3) If front and centre blocks and conduits have been removed, secure them in their respective locations with two nuts and bolts.

(a) Retain one block on its mounting bracket with two nuts and bolts lightly tightened.

(b) Compress ends of centre slotted conduit, engage with installed block and remaining block and retain block on its mounting bracket with two nuts and bolts lightly tightened.

(c) Engage front slotted conduit with front block.

(d) Torque-tighten nuts and bolts on each block
R to 100 lbf in (11,5 Nm).

(4) Align slots of conduits and blocks.

(5) Assemble centre cable to slotted conduits and connect front end to piston.

(a) Assemble centre cable to slotted conduits and blocks. Turn centre conduit to bring slots out of alignment and retain cable.

(b) With locknut removed, position cover and fixed guard over cable end and engage cover with front conduit end.

(c) Align holes of cover and fixed guard and secure to rear mounting bracket with three bolts. Torque-tighten bolts to between 67 and 73 lbf in (7,6 and 8,2 Nm).

(d) Screw locknut on cable end then engage with piston nut threads to full depth of nut with lubricant B applied. Leave locknut slack.

(6) Connect centre and rear cables and install rear block.

(a) Connect centre cable to rear cable and secure with shouldered pin, washer and split pin

(b) Apply lubricant G liberally by brush to the length of rear cable where it is in contact with the rear block and guide bush.

(c) Slide the rear slotted conduit over the cable and connection and, with end compressed, engage fully with centre block bore.

(d) Pre-SB.OL.593-76-9043-72. Ensure that the matched pair, guide bush halves are correctly installed in the hole in the bracket mounted on the turbine exhaust diffuser case.

(e) SB.OL.593-76-9043-72. Ensure that the matched pair, guide bush halves, with the locating pin and retaining plate, are correctly installed in the hole, in the bracket mounted on the turbine exhaust diffuser case.

(f) Simultaneously engage cable with slot of block and, with conduit end compressed, engage block with conduit end and turn block into position on mounting bracket.

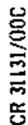
(g) Align block and bracket attachment holes, insert two bolts and secure block to bracket with nuts torque-tightened to between 67 and 73 lbf in (7,6 and 8,2 Nm).

(h) Apply lubricant G liberally by brush to cable in contact with guide bush and block.

(j) Turn conduit slots until they face downward.

(7) Assemble a guard plate to the front block and to the centre block and secure each with a nut and bolt
R torque-tightened to 100 lbf in (11,5 Nm).

(8) Continue with the procedure detailed in paragraph F.



RIGGING PIN
SLEEVE
WITH FULL PENETRATION SLEEVE IS IN
FULL CONTACT WITH NO FREE MOVEMENT
PIN FULLY IN
SECONDARY PLUNGER
PULL OFF PLUNGER
PLUNGER SLEEVE
SHROUD
RIGGING PIN
WARNING LABEL
CORD
SHIELD FRONT
ADAPTER
SHIELD
SHROUD
RESET PLUNGER
DISTRIBUTION AND DUMP VALVE

CMR 76 21 01 4 HAMO

Rearm Details and Alignment Check of
Pull-off Plungers
Figure 408

R

F. Complete the Installation.

(1) Adjust the piston to catch plate position (Ref. 76-21-00 Adjustment/Test).

R CAUTION: THE RESET PLUNGER INCLUDES A RED INDICATOR
R MARK WHICH IS DESIGNED TO BE OUT OF SIGHT
R WHEN THE SYSTEM HAS BEEN SAFELY RESET.
R THIS MARK IS DIFFICULT TO VIEW AND CAN
R DISCOLOUR WITH USE. IT CANNOT BE REGARDED
R AS A RELIABLE METHOD OF ENSURING THAT THE
R SYSTEM IS SET CORRECTLY. ONLY SUCCESSFUL
R USE OF THE RIGGING PIN WILL ENSURE THAT
R THE VALVE OPERATING MECHANISM IS IN THE
R LOCKED POSITION.

(2) Check that the valve operating mechanism has not been disturbed and is armed and locked (Ref. Fig. 408).

R (a) Engage reset tool with recess at rear of reset plunger and press fully in.

(b) Remove nuts and bolts securing shield front adapter to shroud.

(c) Slacken bolts securing shroud to distribution and dump valve.

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(d) Turn shroud and align the slots.

(e) Insert the rigging pin and press fully home through the alignment holes of shroud, plunger sleeve, pull-off plunger and secondary plunger. For check to be acceptable, the pin must press fully home so that all axial movement of its sleeve is taken up.

NOTE: If the pin does not pass through the pull-off plunger alignment hole, the plunger may have been pressed in slightly more than the normal set position. Light rearward pressure on the reset plunger may be necessary.

(f) Remove rigging pin and turn shroud to full extent of slotted flange to close off slots.

CAUTION: ENSURE THAT CABLE IS NOT PULLED AFTER REMOVAL OF RIGGING PIN. A PULL WILL UNLOCK SECONDARY PLUNGER.

(g) Remove each bolt securing shroud to distribution and dump valve separately, apply lubricant A and replace bolt.

(h) Apply lubricant A and assemble the two bolts and nuts to the shield front flanged adapter to shroud flanges.

(j) Check that locking torque of bolts retaining shield to shroud and shroud to distribution and dump valve is not less than 2 lbf in (0,2 N.m).

(k) Torque-tighten shield to shroud retaining nuts and bolts to 40 lbf in. (4,5 N.m).

(l) Check that reset plunger is free to move sideways in and out of the slot by approximately 0.010 to 0.020 in. (0,25 to 0,50 mm) and progressively tighten shroud to distribution and dump valve bolts to 40 lbf in. (4,5 N.m) while ensuring that the reset plunger remains free. If free movement is lost, turn shroud the minimal amount away from the end of the flange slot to a position that will restore the required movement when the bolts are tight.

(3) Close engine bay doors (Ref.71-00-00, Servicing).

DIFFUSER SECTION WITH REAR ASSEMBLY REMOVAL/INSTALLATION

1. General

Access to the rear cable upper connection is obtained from the rear of the turbine exhaust diffuser.

Details of approved servicing and storage materials quoted in this chapter are given in 70-00-01.

R 2. Inspect Conduits

R A. To check if the cable conduits are worn to a point where there is a danger of them moving sideways and damaging the cables the following checks must be carried out on both ends of conduits.

R (1) Check the diametral play between every conduit end and its mounting. Wherever the play is more than 0.015 in. (0,4 mm) in any direction, remove the conduit concerned. Refer to 76-21-01 for removal procedures.

R (2) Inspect the ends of the dismantled conduit for wear. If any conduits are worn to less than 50% of their original thickness at any point, reject them and replace with new parts.

R 3. Rear Cable Assembly - Removal/Installation (Ref.Fig.401)

A. Prepare to Remove Rear Cable Assembly.

(1) Open engine bay rear doors (Ref.71-00-00, Servicing).

(2) Remove reheat injection system (Ref.73-12-06 Removal/Installation).

(3) Remove jet pipe thermocouple (Ref.77-21-02, Removal/ Installation).

Figure 401. Deleted

C. Remove Cable Assembly and Rear Block (Ref.Fig.402).

(1) Detach rear cable from centre cable and free lower end of cable.

(a) Remove nuts and bolts securing rear block to bracket.

(b) Compress conduit ends and press rear block toward centre block to take up full depth of conduit housings.

(c) Without pulling cable and with rear end of conduit compressed, turn rear block, disengage from cable and detach from conduit end.

(d) Compress forward end of conduit and withdraw from middle of block.

(e) Make use of slot in the conduit and slide it off the cable and expose the cable connection.

(f) Remove split pin, washer and shouldered pin from centre/rear cable connection and separate the ends.

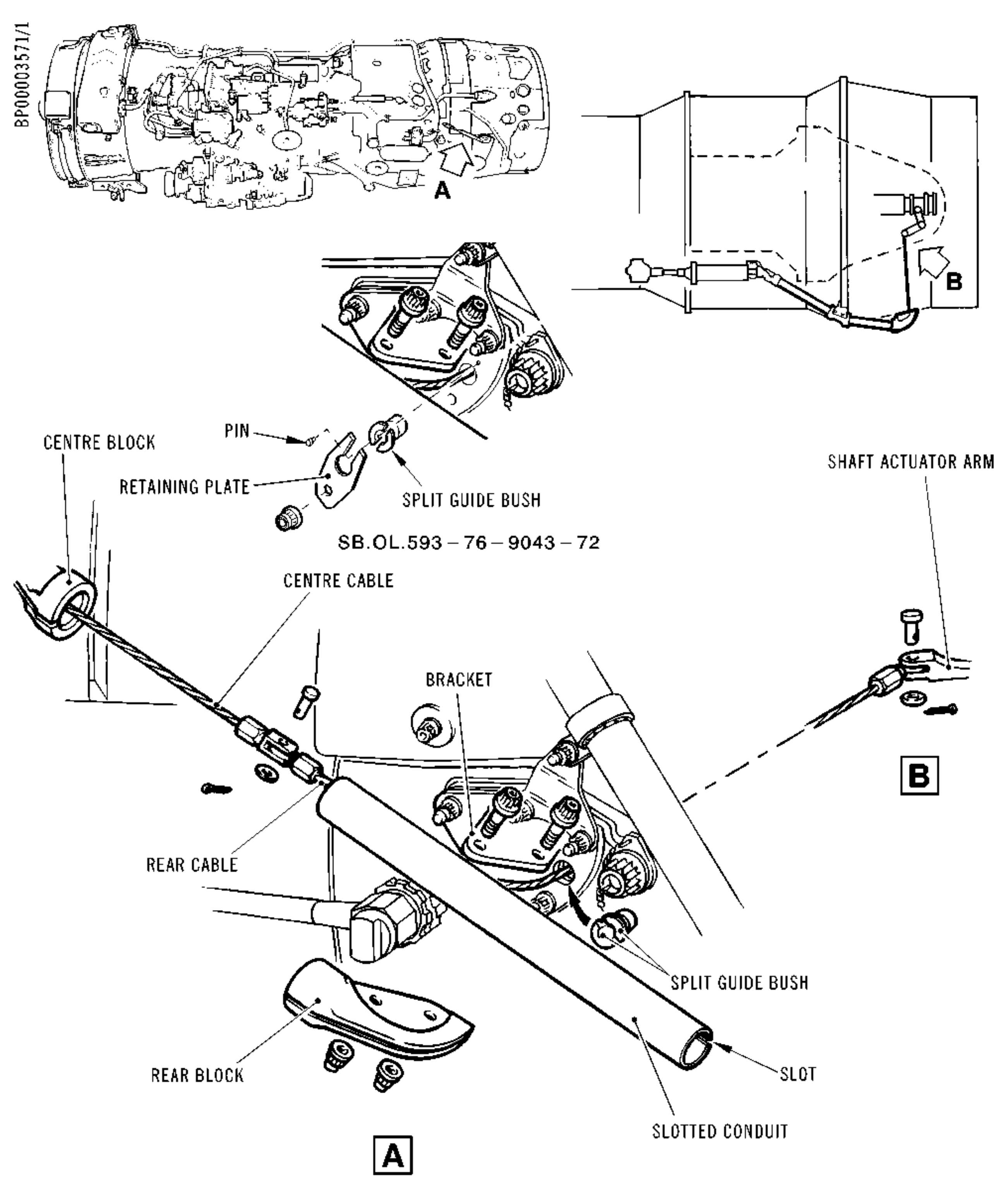
(g) Pre-SB.OL.593-76-9043-72. Remove split guide bush halves.

R (h) SB.OL.593-76-9043-72. Remove nut and retaining plate and remove split guide bush halves.

(2) Withdraw split pin, washer and shouldered pin of cable connection to shaft actuator arm and detach cable.

(3) Withdraw cable through lower aperture.

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Rear Cable Assembly Detail
Figure 402

(4) Examine cable for broken wires as detailed in 76-21-00, Inspection/Check.

D. Install Cable Assembly and Rear Block (Ref. Fig. 402)

WARNING: WASH HANDS AFTER USING LUBRICANT G. LUBRICANT CONTAINS COPPER AND LEAD AND IS TOXIC.

(1) Ensure that the cable meets the requirements detailed
RB in 76-21-00, Inspection/Check. Apply lubricant G
RB (PBCX126G) to the complete length of the LP shutdown
RB rear cable prior to cable installation.

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(2) Locate rear cable in vane and connect cable to shaft actuator arm and secure with shouldered pin, washer and split pin.

R (3) Assemble the split guide bush.

R (a) Pre-SB.OL.593-76-9043-72. Assemble matched
R halves of split guide bush to hole in rear
R block bracket.

R (b) SB.OL.593-76-9043-72. Ensure that the
R locating pin for the split guide bush is
R installed correctly in the rear block
R bracket. Assemble matched halves of split
R guide bush to hole in rear block bracket and
R locate on locating pin. Install the
R retaining plate on the rear block bracket
R with the nut.

(4) Connect rear cable to centre cable and install rear block.

(a) Connect centre and rear cable and secure with shouldered pin, washer and split pin.

(b) Apply lubricant G liberally by brush to the length of rear cable where it is in contact with the rear block and guide bush.

(c) Slide conduit over cable and connection, compress end and engage fully in bore of centre block.

(d) Engage cable with guide portion of block and, with conduit end compressed, engage it fully with rear block bore.

(e) Pre-SB.OL.593-76-9043-72. Ensure that the cable guide bush halves are correctly located, align rear block and bracket attachment holes and insert the two attachment bolts.

(f) SB.OL.593-76-9043-72. Ensure that the locating pin, the cable guide bush halves, the retaining plate and attachment bolt are installed correctly. Align rear block and bracket attachment holes and insert the two attachment bolts.

(g) With lubricant B applied secure rear block to bracket with nuts and bolts torque-tightened to between 67 and 73 lbf in (7,6 and 8,2 Nm.).

(h) Apply lubricant G liberally by brush to the cable in contact with rear block and guide bush.

(j) Turn conduit until slot is out of line with the slots of the centre and rear blocks.

(5) Continue with the procedure detailed in paragraph E.

E. Complete Installation.

(1) Install jet pipe thermocouple (Ref.77-21-02, Removal/ Installation).

(2) Install reheat injection system (Ref.73-12-06, Removal/Installation).

(3) Adjust the piston to catch plate position Ref.76-21-00, Adjustment/Test).

CAUTION: THE RESET PLUNGER INCLUDES A RED INDICATOR MARK WHICH IS DESIGNED TO BE OUT OF SIGHT WHEN THE SYSTEM HAS BEEN SAFELY RESET. THIS MARK IS DIFFICULT TO VIEW AND CAN DISCOLOUR WITH USE. IT CANNOT BE REGARDED AS A RELIABLE METHOD OF ENSURING THAT THE SYSTEM IS SET CORRECTLY. ONLY SUCCESSFUL USE OF THE RIGGING PIN WILL ENSURE THAT THE VALVE OPERATING MECHANISM IS IN THE LOCKED POSITION.

(4) Check that the valve operating mechanism has not been disturbed and is armed and locked.

(a) Engage reset tool with recess at rear of reset plunger and press it fully in.

(b) Remove nuts and bolts securing shield front adapter to shroud.

(c) Slacken bolts securing shroud to distribution and dump valve.

(d) Turn shroud and align the slots.

(e) Insert the rigging pin and press fully home through the alignment holes of shroud, plunger sleeve, pull off plunger and secondary plunger (Ref. Fig.403). Pin must press fully home so that all axial movement of its sleeve is taken up for check to be acceptable.

NOTE: If the pin does not pass through the pull off plunger alignment hole, the plunger may have been pressed in slightly more than the normal set position. Light rearward pressure on the reset plunger may be necessary.

(f) Remove rigging pin and turn shroud to full extent of slotted flange to close off slots.

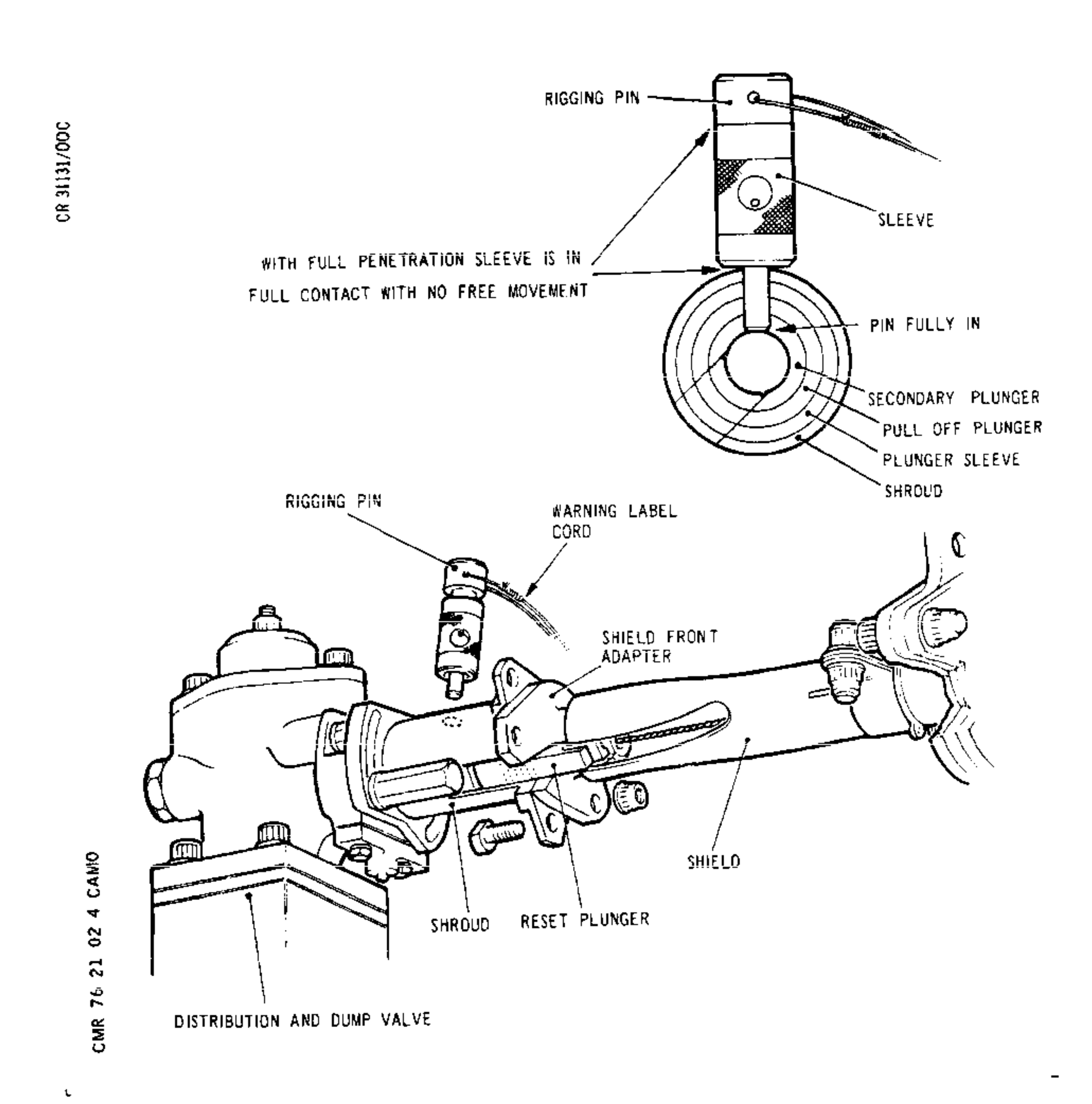
CAUTION: ENSURE THAT CABLE IS NOT PULLED AFTER REMOVAL OF RIGGING PIN. A PULL WILL UNLOCK SECONDARY PLUNGER.

(g) Remove each bolt securing shroud to distribution and dump valve separately, apply lubricant A and replace bolt.

(h) Apply lubricant A and assemble the two bolts and nuts to the shield front flanged adapter to shroud flanges.

(j) Check that locking torque of bolts retaining shield to shroud and shroud to distribution and

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Re-arm Details and Alignment Check
of Pull-off Plungers
Figure 403

R

dump valve is not less than 2 lbf in. (0,2 N.m).

(k) Torque-tighten shield to shroud retaining nuts and bolts to 40 lbf in. (4,5 Nm).

(l) Check that reset plunger is free to move sideways in and out of the slot by approximately 0.010 to 0.020 in. (0,25 to 0,50 mm) and progressively tighten shroud to distribution and dump valve bolts to 40 lbf in. (4,5 N.m) while ensuring that the reset plunger remains free. If free movement is lost, turn shroud the minimal amount away from the end of flange slot to a position that will restore the required movement when the bolts are tight.

(5) Close the engine bay doors (Ref.71-00-00, Servicing).

R 4. <u>Rear Cable - Partial Inspection without Removal of Cable</u>

R A. Gain Access to the Rear Cable Assembly.

R (1) Open engine bay rear doors (Ref.71-00-00, Servicing).

R (2) Remove reheat injection system (Ref.73-12-06, Removal/Installation.

R (3) Remove jet pipe thermocouple (Ref.77-21-02 Removal/ Installation).

R B. Remove the Rear Block (Ref.Fig.402).

R (1) Detach rear cable from centre cable and free lower end of cable.

R (a) Remove nuts and bolts securing rear block to bracket.

R (b) Compress conduit ends and press rear block toward centre block to take up full depth of conduit housings.

R (c) Without pulling cable and with rear end of conduit compressed, turn rear block, disengage from cable and detach from conduit end.

R (d) Compress forward end of conduit and withdraw from middle of block.

(e) Make use of slot in the conduit and slide it off the cable and expose the cable connection.

(f) Remove split pin, washer and shouldered pin from centre/rear cable connection and separate the ends.

(g) Remove split guide bush halves.

C. Examine the cable.

<u>NOTE:</u> Each cable consists of seven strands, each strand consists of fourteen wires.

(1) Examine each wire along its length, as far as possible, looking for broken wires. Flexing the cable will help in finding any breakages.

(2) If no wires are broken, accept the cable for further use.

(3) If between one and fifteen wires are broken in any 1,5 in. (38 mm) length, then the cable is acceptable, but must be replaced within the next 250 cable hours. If more than fifteen cables are broken in any 1.5 in. (38 mm) length, then remove the cable and install a new cable, as detailed in 76-21-02, Rear Cable Assembly - Removal/Installation.

(4) If the original cable has been retained, assemble the system as detailed in 76-21-02, Rear Cable Assembly - Removal/Installation.

END OF THIS SECTION

NEXT